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ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

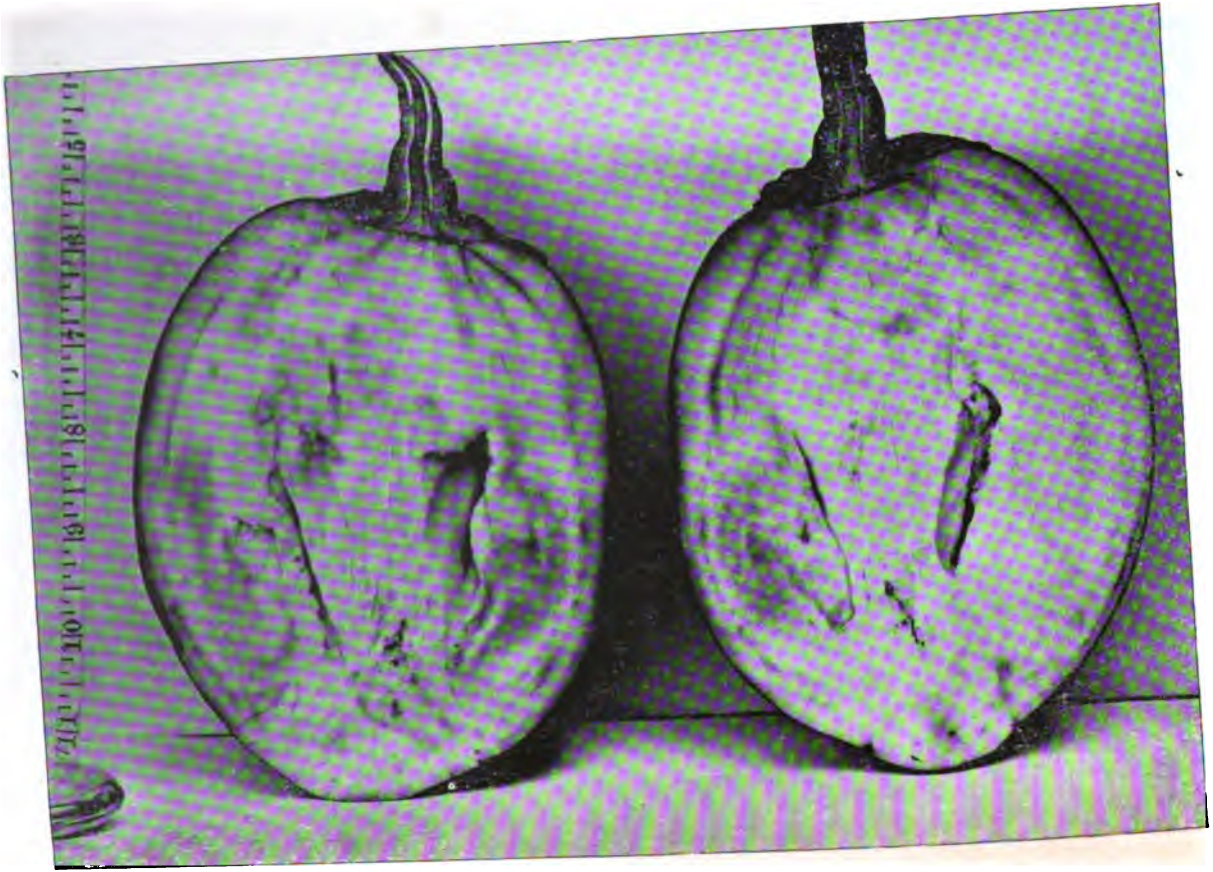
AGRICULTURAL EXPERIMENT STATIO

ORONO, MAINE.

1892.

MA

BANGOR:
CHAS. H. GLASS & CO., PRINTERS,
1893.



SEEDLESS EGG FRUIT. See Page 46.

ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

AGRICULTURAL EXPERIMENT STATION

ORONO, MAINE.

1892.

BANGOR:
CHAS. H. GLASS & CO., PRINTERS,
1893.

MAINE STATE COLLEGE,

AGRICULTURAL EXPERIMENT STATION.

STATION COUNCIL.

B. F. BRIGGS, ESQ., Auburn, **RUTILLUS ALDEN**, ESQ., Winthrop, **ARTHUR L. MOORE**, ESQ., Waterville.	Committee of Trustees.

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M. C. FERNALD, PH. D., ... President College.

PRESIDENT.

W. H. JORDAN, M. S.. . . . . Director Station,

SECRETARY.

WALTER BALENTINE. M. S. . . . . Professor of Agriculture.

F. L. HARVEY, Ph. D., . . . Professor of Natural History.

F. L. RUSSELL, V. S., ... Veterinarian to Station.

W. M. MUNSON, B. S., ... Professor of Horticulture.

STATION OFFICERS.

W. H. JORDAN, M. S.	Director.
M. C. FERNALD, PH. D,.	Meteorologist.
WALTER BALENTINE, M. S.,	Experimental Agriculture.
F. L. HARVEY, PH. D.,	Botanist and Entomologist.
J. M. BARTLETT, M. S.,	Chemist.
L. H. MERRILL, B. S.,	Chemist.
F. L. RUSSELL, V. S.,	Veterinarian.
W. M. MUNSON, B. S.,	Horticulturist.
F. P. BRIGGS, B. S.	Assistant in Botany and Entomology.
H. P. GOULD,	Assistant in Horticulture.
A. M. SHAW,	Foreman on Farm.
MRS. J. HAMLIN WAITT,	Stenographer and Clerk.

TREASURER'S REPORT.

THE MAINE AGRICULTURAL EXPERIMENT STATION.

In account with

THE UNITED STATES APPROPRIATION.

RECEIPTS.

From the Treasury of the United States as per appropiation for the year ending June 30, 1892	$15,000 00

EXPENDITURES.

Chemical Laboratory	$ 434 54	
General Expense	297 77	
Field and Feeding	790 34	
Horticultural Department	793 34	
Head House	468 93	
Library	62 97	
Printing	1,667 35	
Stationery and Postage	108 00	
Travelling Expenses	147 00	
Trustee Expenses	50 40	
Construction and Repairs	277 19	
Botany and Entomology	33 50	
Fertilizer Inspection	209 16	
Meteorology	20 50	
Veterinary Science	28 46	
Fuel Account	294 45	
Salaries	9,316 10	
		$15,000 00

I hereby certify that the above is a correct statement of the amount expended by the Maine Experiment Station for the year ending June 30, 1892.

GEO. H. HAMLIN,
Treasurer of Trustees, Maine State College of Agriculture and the Mechanic Arts.

I hereby certify that I have examined the accounts of the Maine Experiment Station for the fiscal year ending June 30, 1892: that I have found the above to be a correct statement of expenditures both as to amount and classification, for all of which proper vouchers are on file.

HENRY LORD,
Audtior of the Trustees, Maine State College of Agriculture and the Mechanic Arts.

I hereby certify that the above are the signatures of the Treasurer and Auditor of the Trustees of the Maine State College of Agriculture and the Mechanic Arts.

W. H. JORDAN,
Director of Station.

DIRECTOR'S REPORT.

M. C. Fernald, Ph. D., President Maine State College:

SIR:—The work of the Maine Experiment Station for the year 1892, a report concerning which I have the honor to submit herewith, has been conducted along the lines previously established. It has included the following: 1st, inspection of fertilizers; 2d, analyses of cattle foods, including certain patent foods which are offered for sale at greatly advanced prices. An attempt has been made to demonstrate to the farmer the very poor economy of purchasing the latter. 3d, investigations concerning the secondary effects of pollination. In presenting these results, Prof. Munson has taken the occasion to collect in the form of a monograph all the avilable information which has been published on the subject. 4th, experimental work on varieties and methods of treatment of certain garden vegetables, including cabbages, tomatoes and egg plants. 5th, contents, cultivation and care of small and large fruits which are being tested. 6th, spraying experiments, specially with reference to the apple scab and codling moth. 7th, the identification and description to inquirers of such injurious plants and insects as are sent to the Station. 8th, investigations in plant nutrition bearing upon the economical use of crude fertilizing materials. 9th, digestion experiments. 10th, feeding experiments with swine and milch cows.

PUBLICATIONS OF THE STATION.

The publications of the Station by means of which the results of the above experiments and investigations are set forth have consisted of a report issued in five parts. In this report have been included everything excepting the digestion and feeding experiments. These have so far been in the immediate charge of the Director of the Station, but owing to increased duties in connection with the World's Fair, he has not been able either to undertake the past season as extensive experiments or to report them as promptly as otherwise would have been the case. Only a limited edition of Part 2, of the report (Secondary Effects of Pollination) was issued as it was sent out only to newspapers, experiment stations and experiment station workers. The reason for this was that the publication was of a strictly scientific nature and while presenting the results which it is hoped will lead to practical conclusions eventually, its contents were of such a nature as to be of little general interest. Besides the five parts of the station report, there was also issued a bulletin on the Babcock Milk Test and six newspaper bulletins, the latter being designed as a concise and simple statement of the outcome of certain practical experiments.

STATION EXHIBIT AT THE COLUMBIAN EXPOSITION.

At a meeting of the association of colleges and experiment stations held at Champaign, Ill., in November, 1890, it was voted that the experiment stations unite with the United States Department of Agriculture in making a co-operative exhibit at the Columbian Exposition. A committee of five was appointed to act in conjunction with the Central Office of Experiment Stations in forming and executing plans for this exhibit. It was decided that instead of inviting each experiment station to make an individual exhibit, thus causing very much of repetition, it would be better to co-ordinate the total exhibit into sections, each section to represent a particular subject. I was invited to take immediate charge of the section devoted to Animal Nutrition and after consultation with yourself agreed to do so. It was evident from the first that because of the nature of this subject, the exhibit could not consist so much of objects of special interest as of a graphic display of results. For instance, it was very evident that the main factor of the exhibit must be a display of the relation of food and growth under varying conditions, and if such a display were to mean anything as an expression of the work of American experiment stations, it must be based upon their experimental data. This necessitated the review of all the station literature bearing upon experiments in animal nutrition. All the experiment stations that had conducted feeding experiments were invited to assist in this work, and some of them very kindly furnished the data of their own feeding experiments so arranged and digested as to be immediately useful in obtaining certain necessary general averages. The required data from swine feeding experiments were very kindly furnished by the Office of Experiment Stations from manuscript prepared by Dr. Armsby, of State College, Pa.

In order to obtain the necessary figures pertaining to milk production and the growth of bovines and sheep, there were used the results of one hundred and twelve feeding experiments made by American stations. As before stated, many of these results were put into the desired form by the stations making the experiments, but considerably more than half of them were worked up in this office from the original data. Moreover, a large part of the exhibit itself has been prepared here. All of this required my personal attention. I make the above statements as an explanation why that line of experimental work in which I am immediately interested has been to some extent neglected.

INSPECTION OF FERTILIZERS.

As in previous years, the time of the station force has in part been devoted to the inspection of fertilizers. There is a fair prospect that this will not again be done at the expense of the funds supplied by the United States Government. It now appears probable that the Legislature soon to meet will be asked to enact a law which will provide for the expense of this inspection either by direct appropriation from the State, or by requiring a license fee from fertilizer manufacturers doing business in the State. The movement in this direction has the approval of members of the Board of Agriculture and of others who understand the exegencies of the case.

WORK IN PLANT NUTRITION.

Through you I desire to urge upon the attention of the Board of Trustees a proposed enlargement of our work in plant nutrition. Since the establishment of the Experiment Station under the provisions of the Hatch Act, the experiments and investigations in plant feeding have been under the immediate charge of Prof. Balentine. He has attempted to reach beneficial results through field experiments on the College Farm, through experiments conducted by farmers in different parts of the State, and through more or less experimentation in pots with a view to a more exact work than can be done in the field.

It is very evident and has been for some time that not only are the errors of field experimentation very large, but that the usefulness of this method of work is limited to the testing of theories as to the correct methods of maintaining fertility. An exact study of the fact and principles of plant nutrition must be accomplished by some other method. It is a noticable fact that American Experiment Stations are giving comparatively little attention to this subject, at least in the way of rigid scientific investigation, and an inviting and important field of work seems to be open. The nutrition of animals has received a much larger amount of attention.

Experiments now under way in the forcing house give promise of a far greater degree of success than has been possible under previously existing conditions and Prof. Balentine is desirous that there shall be erected a new forcing house which shall be entirely utilized, for a time at least, by experiments of this kind. This idea has my most hearty endorsement and through you I wish to urge upon the trustees the importance of developing this line of investigation. The present forcing house is entirely inadequate to accommodate any additional experiments. As this new forcing house would stand in a prominent place, it should be somewhat more ornamental than the one already built, and not less than $1,500 should be available for its construction.

ACKNOWLEDGEMENTS.

The Experiment Station is under obligation to the following parties for gifts of various kinds:

DONATIONS 1892.

O. M. Lord, Minnesota City, Minn., apple cions.

J. S. Harris, La Crescent, Minn., apple cions.

C. G. Patten, Charles City, Iowa, apple cions.

Jewel Nursery Co., Lake City, Minn., 6 Thompson Seedling Apple Trees; 6 Windom Dewbery; 6 North Star Currants.

Ellwanger & Barry, Rochester, N. Y., specimen fruits of autumn pears.

Field Force Pump Co., Lockport, N. Y., 1 Little Gem spraying pump.

The following newspapers and other publications are kindly donated to the Station by the publishers during 1892:

Farmers' Home, Dayton, Ohio.
Holstein Friesian Register, Boston, Mass.
Farm and Home, Springfield, Ill.
Jersey Bulletin, Indianapolis, Ind.
Monthly Bulletin, Philadelphia, Pa.
Farmers' Advocate, London, Ont.
Maine Farmer, Augusta, Me.
Southern Cultivator, Atlanta, Ga.

American Dairyman, New York, N. Y.
The Pharmaceutical Era, Detroit, Mich.
The Sun, Baltimore, Md.
Massachusetts Ploughman, Boston, Mass.
Practical Farmer, Philadelphia, Pa.
New England Farmer, Boston, Mass.
Louisana Planter, New Orleans, La.
Mirror and Farmer, Manchester, N. H.
Texas Farmer, Dallas, Texas.
Hoard's Dairyman, Ft. Atkinson, Wis.
Iowa Farmer and Breeder, Cedar Rapids, Iowa.
Detroit Free Press, Detroit, Mich.
Orange County Farmer, Port Jervis, N. Y.
Farm Journal, Philadelphia, Pa.
Delaware Farm and Home, Wilmington, Del.
The Western Rural, Chicago, Ill.
American Cultivator, Boston, Mass.
Farmers' Review, Chicago, Ill.
The Rural Canadian, Toronto, Ont.
Vick's Magazine, Rochester, N. Y.
The Farm and Dairy, Ames, Iowa.
The Clover Leaf, So. Bend, Ind.
New York World. (weekly)
The Grange Visitor, Lansing, Mich.
The Industrial American, Lexington, Ky.
The American Grange Bulletin and Scientific Farmer, Cincinnati, Ohio.
Agricultural Epitomist, Indianapolis, Ind.
The Prairie Farmer, Chicago, Ill.

W. H. JORDAN,
Director.

MAINE STATE COLLEGE,
ORONO, ME., Dec. 31, 1892.

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INSPECTION OF FERTILIZERS.

The inspection of fertilizers by the Maine Experiment Station for the year 1892 has required the analysis of seventy-four brands of mixed fertilizers involving the selection of one hundred and ninety samples. In order to secure these samples, it has been necessary to send an agent into nearly every section of the State. Samples were taken in forty one cities and townships, often at several points in the same township. An effort is made to begin this work in March, but it is usually found that new goods have been shipped to but few places so that a successful canvass of the State can not be carried on until April, therefore the completion of the sampling and analytical work can not be reached until late in June. It will be noticed that three samples of each brand have not been secured in all cases.

In general this has been owing to the following causes: Selling of the fertilizer at but very few points, and finding only the goods held over from last year's sales in the hands of nearly all the agents visited.

SELECTION OF SAMPLES.

Samples for 1892 were selected by Mr. S. H. T. Hayes, an agent of the Station, acting under its instructions. The samples were drawn from three or four packages, mostly one hundred pound bags, so that in all cases where three samples were taken the analysis represents from nine to twelve packages of the goods. In some cases as many as five samples were taken.

The drawing of the samples is accomplished by means of a sampling tube which can be made to reach every portion of the package, and as several drafts are made from each package, it is readily seen that the method of taking samples is a very thorough one, and there is no good reason for supposing that the contents of the glass jar that is forwarded to the Station do not fairly represent the goods sampled. In every instance a sample exactly similar in composition to the one taken to the station is left in the hands of the agent selling the goods, thus giving the manufacturers an opportunity, by procuring an analysis of this sample, to check the analytical work of the Station.

THE TRADE VALUES OF FERTILIZERS FOR 1890.

The trade values given below which are used by this Station are those "agreed upon by the experiment stations of Massachusetts, New Jersey, Rhode Island and Connecticut for use in their respective states during 1892. The valuations obtained by use of the following figures will be found to agree fairly with the *average retail price* at the large markets of standard raw materials such as:"

Sulphate of Ammonia,
Nitrate of Soda,
Dried Blood,
Muriate of Potash,
Sulphate of Potash,
Azotin,
Ammonite,
Dry Ground Fish,
Bone or Tankage,
Ground So. Carolina Rock,
Plain Superphosphates.

	Cts. per lb.
Nitrogen in ammonia salts	17½
nitrates	15
Organic nitrogen in dry and fine ground fish, meat and blood	16
in cotton seed meal and castor pomace	15
in fine bone and tankage	15
in fine medium bone and tankage	12
in medium bone and tankage	9½
in coarser bone and tankage	7½
in hair, horn shavings and coarse fish scrap	7
Phosphoric acid, soluble in water	7½
" in ammonium citrate	7
in dry ground fish, fine bone and tankage	7
in fine-medium bone and tankage	5½
in medium bone and tankage	4½
in coarser bone and tankage	3
Potash as high-grade Sulphate and in forms free from Muriate or Chlorides	5½
as muriate	4½

"These trade values are the average prices at which in the six months preceding March the respective ingredients could be bought at retail for cash in our large markets, Boston, New York and Philadelphia, in the raw materials which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations."

The sale of "standard raw materials" in Maine is too small to allow an estimation of values upon the basis of local market prices, so the figures as agreed upon in other New England States, where the subject is very ably and thoroughly studied, are taken for use by this Station.

THE VALUATION OF SUPERPHOSPHATES AND MIXED GOODS.

These trade values are applied to the valuation of Superphosphates and all mixed goods, as follows:

It is assumed that the organic nitrogen of these goodhass for its source such materials as dried blood, ground fish, or nitrogenous substances of equally good quality, unless a special examination of some particular brand shows that inferior material like leather has been used. Organic nitrogen in mixed goods is therefore valued at sixteen cents per pound. As nitrogen in nitrates is rated for 1892 at only a cent less per pound than organic nitrogen, and as with but few exceptions the nitrates are present in very small quantities, no difference has been made in computing the "estimated value" between organic and nitric nitrogen, but both have been valued at sixteen cents. The small increase in the "estimated value" thus caused, while slightly favorable to certain manufacturers, can certainly do the consumer no serious harm. The nitrogen present in ammonia salts is reckoned at seventeen and one-half cents.

The insoluble phosphoric acid of mixed fertilizers is reckoned at two cents per pound, coming as it does largely from mineral phosphates, and in any case being much the least valuable portion of the original material.

The potash is valued at the price of that ingredient in the muriate, unless the chlorine present in the fertilizer is not sufficient to combine with it, in which case the excess of potash is reckoned at the price of the sulphate.

The valuation of a fertilizer is obtained by multiplying the percentages of the several ingredients by twenty (which gives the pounds per ton), and these products by the prices per pound, and the sum of the several final products is the market value of the fertilizing ingredients in one ton. For instance the "station valuation" of fertilizer No. 855 was obtained as follows:

2.65%	Nitrogen,	53. lbs. per ton	@ 16 cts.	—$8.48.
6.26%	Soluble Phos. Acid,	125.2 " " "	@ 7½ "	— 9.39.
3.80%	Rev. " "	76. " " "	@ 7 "	— 5.32.
1.22%	Insol. " "	24.4 " " "	@ 2 "	— .49.
1.77%	Potash,	35.4 " " "	@ 4½ "	— 1.59.
			Valuation,	$25.27

Change in Method.

In past years separate analyses have been made of the samples representing the same fertilizer. At present equal quantities of all the samples are mixed, and an analysis of this mixture is assumed to give the same result as would be reached by averaging the analyses of the several samples, a method which is undoubtedly correct.

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
997	Alkaline Bone	E. Frank Coe, New York, N. Y.,	W. P Bessey, Freedom	
855	Americus Amm. Bone Superphosphate	Williams & Clark Fert. Co., New York, N. Y.,	S. D. Edwards, Oxford	$36.00
868			Carleton Bros., Portland	32.00
963			L. A. Knowlton, Belfast	35.00
869	Americus Corn Phosphate	Williams & Clark Fert. Co., New York, N. Y.,	Carleton Bros., Portland	32.00
959			E. B. Gardner, Bucksport.	
974			L. A. Knowlton, Belfast	36.00
957	Amm. Bone Super. (Standard Grade)	E. Frank Coe, New York, N. Y.,	Morrison & Joy, Ellsworth	36.00
981			A. A. Howes, Unity	
986			S. L. Small, Dexter	32.00
859	Bay State Fertilizer for Seeding Down	Clark's Cove Fert. Co., New Bedford, Mass.,	A. A. Mitchell, Portland	
971			L. A. Knowlton, Belfast	27.00
1017			J. L. Bridgham, No. Auburn	
990	B. D. Sea Fowl Guano	Bradley Fertilizer Co., Boston, Mass.,	L. F. Ireland, Corinna	31.00
1029			Willis Cobb, Winthrop	
1035			Steward Bros., Skowhegan.	30.00
853	Bowker's Amm. Bone Fertilizer	Bowker Fertilizer Co., Boston, Mass.,	S. P. Wardwell, Ea. Oxford	
995			Edwin Chick & Co., Bangor	35.00
1034			Steward Bros., Skowhegan.	35.00
1027	Bowker's Farm and Garden Phosphate	" " " " "	F. L. Butler, Farmington	

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
897	Bowker's Hill and Drill Phosphate	Bowker Fert. Co., Boston, Mass.,	F. R. Fenson, Turner's Cor.	
983			Co-operative Store, Dexter.	$36.00
1003			A. W. Ward, Thorndike	33.00
832	Bowker's Potato Manure,	Bowker Fert. Co., Boston, Mass.,	S. P. Wardwell, Ea. Otisfield	
944			E. E. Parkhurst, Presque I.	38.00
952			Hiram Smith, Houlton	38.00
951	Bowker Potato Phosphate		Hiram Smith, Houlton	36.00
1010	Bowker's Square Brand Bone and Potash		B. F. Curtis, Richmond	27.00
1023			J. P. Merrill, Auburn	27.00
1004	Bowker's Sure Crop Bone Phosphate		A. W. Ward, Thorndike	28.00
947	Bradley's Com. Manure for Potatoes and Veg't'le	Bradley Fert., Co., Boston, Mass.,	A. H. Fogg & Co., Houlton.	40.00
979			A. A. Howes, Belfast	
1088			R. B. Dunning, Bangor	40.00
873	Bradley's Eureka Seeding Down Fert.		Kendall & Whitney, Portl'nd	26.00
914			Hunter & McMaster, Pittsfield	
915			R. B. Dunning, Bangor	26.00
857	Bradley's Potato Manure		Hawkes & Whitney, M'c F'lls	36.00
874			Kendall & Whitney, Portl'nd	34.00
906			Cunningham & Sager, Gard.	36.00
913			Hunter & McMaster, Pittsf'ld	
924			L. K. Cary, Fort Fairfield	38.00

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
858	Bradley's X. L. Superphosphate	Bradley Fertilizer Co., Boston, Mass.	G. O. Goodwin, Mech. Falls	36.00
872			Kendall & Whitney Portln'd	34.00
905			Cunningham & Sager, Gard'r	36.00
936			Carl Ullric, Caribou	36.00
991			F. L. Ireland, Corinna	34.00
863	Clark's Cove Bay State Fertilizer	Clark's Cove Fertilizer Co., New York, N.Y.	A. A. Mitchell, Portland	
907			W. M. True, Waterville	36.00
920			D. Morrill, Bangor	34.00
928			L. K. Cary, Fairfield	38.00
848	Clark's Cove Bay State G. G		Benj. Tucker, Norway	30.00
860			A. A. Mitchell, Portland	
921			D. Morrill, Bangor	32.00
903			Robert Pope & Co., Gardin'r	35.00
879	Cleveland Potato Phosphate	Cleveland Dryer Co., Boston, Mass.,	Carleton Bros., Portland	32.00
901			F. P. Morrill, Gardiner	
1022			E. H. Libbey, Auburn	31.50
878	Cleveland Seeding Down Fertilizer		Carleton Bros., Portland	30.00
900			F. P. Morrill, Gardiner	
1015			E. H. Libbey, Auburn	26.50
880	Cleveland Superphosphate		Carleton Bros., Portland	32.00
902			Geo. H. Pope, Gardiner	
1016			E. H. Libbey, Auburn	1.50

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
889	Crocker's Corn Phosphate	Crocker Fert. & Chem. Co., Buffalo, N. Y.,	Geo. H. True, Freeport	
976			L. A. Knowlton, Belfast	$36.00
1008			B. F. Curtis, Richmond	36.00
1046	Concentrated Phosphatic Rock	Cumberland Bone Co., Portland,	College Farm, Orono	
849	Cumberland Superphosphate		Benj. Tucker, Norway	32.00
875			Cumb'l'd Bone Co., Portland	30.00
916			R. B. Dunning, Bangor	32.00
917	Cumberland Potato Fertilizer		R. B. Dunning, Bangor	36.00
933			A. L. Haines, Fort Fairfield	36.00
941			W. H. Bragdon, Perham	36.00
942			E. E. Parkhurst, Presque I.	36.00
877	Cumberland Seeding Down Fertilizer		Cumb'l'd Bone Co., Portland	25.00
966			L. A. Knowlton, Belfast	
996			E. Conforth, Thorndike	26.00
892	Dirigo Fertilizer	Sagadahoc Fertilizer Co.,	Sag. Fert. Co., Bowdoinham	25.00
911			A. R. Smith, Clinton	26.00
987			Geo. A. Tibbetts, Corinna	26.00
918	Farrar's Potato Phosphate	F. S. Farrar & Co., Bangor Me.,	Whitney & Cameron, Bangor	34.00
919	Farrar's Superphosphate		Whitney & Cameron, Bangor	32.00
1041			K. Pooler, Stillwater	35.00

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
881	Grass and Grain Fertilizer	E. Frank Coe, New York, N. Y.,	S. H. Fitz, Freeport	
9'8			Morrison & Joy, Ellsworth	$29.50
980			A. A. Howes, Unity	
985			S. L. Small, Dexter	26.00
1039	Great Eastern General Corn Manure	Great Eastern Fertilizer Co.,	Loud & Wilson, E. Newport	34.00
1042			K. Pooler, Stillwater	35.00
1044			H. H. Page, Orono	35.00
1040	Great Eastern General Potato Manure		Loud & Wilson, E. Newport	34.00
1043			H. H. Page, Orono	35.00
862	Great Planet Manure	Clark's Cove Fertilizer Co., New Bedford, Mass.	A. A. Mitchell, Portland	
922			D. Morrill, Bangor	36.00
999	Ground Bone and Potash	E. Frank Coe, New York.,	Geo. E. Bryant, Knox	
856	High Grade Amm. Bone Superphosphate		G. O. Goodwin, Mech'c F'lls	33.00
885			S. H. Fitz, Freeport	
912			Hunter&McMaster Pittsfield	35.00
927			L. K. Cary, Ft. Fairfield	38.00
847	King Phillip Alkaline Guano	Clark's Cove Fertilizer Co.,	Benj. Tucker, Norway	30.00
861			A. A. Mitchell, Portland	
908			W. M. True, Waterville	31.00
923			D. Morrill, Bangor	30.00
954	May Flower Fertilizer	John S. Reese & Co., Baltimore, Md.,	Smith & Van Allen Houlton	33.00
955	New England Favorite		Smith & Van Allen, Houlton	35.00

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
888	New Rival Amm. Superphosphate	Crocker Fert. & Chem. Co., Buffalo, N. Y.,	Geo. H. True, Freeport	
977	" " " "	" " " " " "	L. A. Knowlton, Belfast	$30.00
1013	Nobsque Guano	Pacific Guano Co., Boston, Mass.,	Carleton Bros., Portland	26.00
984	Original Bay State Bone Superphosphate	J. A. Tucker & Co., Boston, Mass.,	E. G. Libbey, Dexter	33.00
998			E. Cornforth, Thorndike	33.00
1020			N. Dayton Bolster, Paris	34.00
978	Original Coe's Superphosphate	Bradley Fertilizer Co., Boston, Mass.,	A. A. Howes, Belfast	
1036			Steward Bros., Skowhegan.	
1005	Otis Superphosphate	S. G. Otis, Hallowell, Me.,	Willis, Kittredge, Cottle & Co. Hallowell	
1018			Chas. E. Freeman, Norway.	31.50
953	Pilgrim Fertilizer	John S. Reese & Co., Baltimore,	Smith & Van Allen, Houlton	30.00
926	Potato Fertilizer, High Grade	E. Frank Coe, New York,	L. K. Cary, Ft. Fairfield	38.00
948			W. G. Brown, Houlton	35.00
890	Potato Hop and Tobacco Phosphate	Crocker Fert. and Chem. Co., Buffalo, N. Y.,	Geo. H. True, Freeport	
929			L. K. Cary, Ft. Fairfield	38.00
946			R. J. Smith, Presque Isle	36.00
1021	Plymouth Rock Fertilizer	Ames Fertilizer Co., Peabody, Mass.,	J. V. McKinney, Auburn	

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
881	Quinnipiac Phosphate	Quinnipiac Co., Boston,	Carleton Bros., Portland	$36.00
895			Wm. Grant, Randolph	
962			N. S. Kent, Bucksport	37.00
964			L. A. Knowlton, Belfast	35.00
882	Quinnipiac Potato Manure	" " "	Carleton Bros., Portland	36.00
896			D. G. Given, Turner's Cor.	
960			N. S. Kent, Bucksport	37.00
973			L. A. Knowlton, Belfast	36.00
883	Quinnipiac Seeding Down Manure	" " "	Carleton Bros., Portland	32.00
961			N. S. Kent, Bucksport	30.00
967			L. A. Knowlton, Belfast	30.00
956	Reeves' Potato Special Corn Manure	John S. Reese & Co., Baltimore, Md.,	Smith & Van Allen, Houlton	40.00
899	Royal Bone Phosphate	Williams & Clark Co., Boston,	F. W. Chadwick, N. Whitefi'ld	
970			L. A. Knowlton, Belfast	30.00
1025			E. W. Verrill, Auburn	
893	Sagadahoc Superphosphate	Sagadahoc Fertilizer Co.,	Sag. Fert. Co., Bowdoinham	30.00
910			A. R. Smith, Clinton	30.00
989			Geo. A. Tibbetts, Corinna	32.00
871	Soluble Pacific Guano	Pacific Guano Co., Boston,	Carleton Bros., Portland	35.00
904			Robert Pope & Co., Gardiner	35.00
909			W. M. True, Waterville	34.00
945			E. L. Tarbell, Presque Isle	35.00
993	Soluble Pacific Special Potato Manure	" " " "	D. Morrill, Bangor	

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
884	Soluble Pacific Special for Tobacco and Potatoes	Pacific Guano Co., Boston,	Carleton Bros., Portland....	$35.00
972			L. A. Knowlton, Belfast....	33.00
1045	South Carolina Rock (Lowe)...................	Bowker Fertilizer Co., Boston,	College Farm, Orono.......	
891	Special Potato Fertilizer.......................	Sagadahoc Fertilizer Co., Bowdoinham,	Sag. Fert. Co., Bowdoinham	34.00
932			A. L. Haines, Ft. Fairfield.	36.00
938			Geo. A. Tibbetts, Corinna..	35.00
1019			C. B. Cunningham & Son, Norway..	36.00
940			E. A. Goodwin, Caribou...	36.00
925	" " "	E. Frank Coe, New York,	L. K. Cary, Ft. Fairfield...	40.00
937			Irving & Ricker, Caribou..	33.00
949			W. G. Brown, Houlton....	35.00
864	Standard A Brand, Seeding Down............	Standard Fertilizer Co., Boston..............	Carleton Bros., Portland...	30.00
968			L. A. Knowlton, Belfast...	30.00
1000			S. S. Downs, Thorndike....	27.00
850	Standard Fertilizer..........................		C.B.Cummings&SonNorw'y	32.00
865			Carleton Bros., Portland...	32.00
930			Thurlow, Richards & Co., Ft. Fairfield..	33.00
939			S. S. Hackett, Caribou.....	33.00
866	Standard Guano............		Carleton Bros., Portland...	30.00
931			Thurlow, Richards & Co., Ft. Fairfield..	35.00
988			S. S. Hackett, Caribou.....	35.00

DESCRIPTION OF SAMPLES.

Station Number.	Brand.	Manufacturer.	Dealer.	Selling Price.
992 1012	Standard Potato Fertilizer	Standard Fertilizer, Boston, Mass.,	D. Morrill, Bangor Carleton Bros., Portland	
960 994 1011	Standard Superphosphate		L. A. Knowlton, Belfast D. Morrill, Bangor Carleton Bros., Portland	$37.00 32.00
1001 1006 1030	Stockbridge Manure for Corn	Bowker Fertilizer Co., Boston,	A. W. Ward, Thorndike B. F. Curtis, Richmond W. H. Keith, Winthrop	40.00 41.00 40.00
1032	Stockbridge Manure for Onions		W. M. True, Waterville	42.00
851 898 934 943 950	Stockbridge Manure for Potatoes		S. P. Wardwell, E. Otisfield F. R. Benson, Turner's Cor. A. L. Haines, Ft. Fairfield. E. E. Parkhurst. Presque I. Hiram Smith, Houlton	 42.00 42.00 40.00
1002	Stockbridge Manure for Roots		A. W. Ward, Thorndike	40.00
1024	Stockb'ge Man. for Small Fruits and Strawberries		J. P. Merrill, Auburn	42.00
982 1032	Stockbridge Manure for Top Dressing		Co-operative Store, Dexter. Wm. True, Waterville	40.00 42.00
1007	Stockbridge Manure for Vegetables		B. F. Curtis, Richmond	41.00
1014	Sulphur and Tobacco Lawn Fertilizer	F. C. Sturtevant, Hartford, Conn.,	W. C. Sawyer, Portland	50.00
854 870 965	Williams & Clark Potato Phosphate	Williams & Clark Fertilizer Co., Boston,	S. D. Edwards, Oxford Carleton Bros., Portland L. A. Knowlton, Belfast	36.00 36.00 35.00

RESULTS OF ANALYSES.

Station Number.	Brand.	Moisture %	Nitrogen %	Phosphoric Acid.					Potash %	Station Valuation.			
				Soluble %	Reverted %	Insoluble %	Total %	Available %		Value of nitrogen $	Value of phosphoric acid $	Value of potash $	Total valuation $
997	Alkaline Bone	9.45	1.24	6.45	2.53	8.44	12.42	8.98	1.86	3.97	14.59	1.96	20.52
835	Americus Amm. Bone Superphosphate	18.60	2.65	6.26	3.80	1.22	11.28	10.06	1.77	8.48	15.20	1.59	25.27
869	Americus Corn Phosphate	13.45	2.29	7.39	2.71	1.82	11.92	10.10	1.57	7.33	15.60	1.41	24.34
957	Amm. Bone Superphosphate (Standard Grade)	8.90	1.70	5.81	2.50	4.39	12.70	8.31	1.21	5.44	13.97	1.27	20.68
859	Bay State Fertilizer for Seeding Down	15.20	1.25	5.91	2.65	1.84	10.40	8.56	2.28	4.00	13.31	2.05	19.36
990	B. D. Sea Fowl Guano	13.05	2.32	7.25	2.59	1.80	11.64	9.84	1.62	7.42	15.23	1.46	24.10
853	Bowker's Amm. Bone Fertilizer	11.00	2.30	6.77	1.58	4.72	13.07	8.35	2.57	7.36	14.25	2.31	23.92
1027	Bowker's Farm and Garden Phosphate	10.70	2.22	6.72	1.15	4.54	12.41	7.87	2.34	7.10	13.51	2.11	22.72
897	Bowker's Hill and Drill Phosphate	11.95	2.70	7.16	2.78	2.42	12.36	9.94	2.17	8.64	15.60	1.95	26.19
852	" Potato Manure	7.70	2.53	4.04	3.63	7.11	14.78	7.67	7.14	8.10	13.98	6.43	28.51
951	" " Phosphate	11.95	2.47	6.46	1.47	4.04	11.07	7.93	2.48	7.90	13.37	2.23	23.50

RESULTS OF ANALYSES.

Station Number.	Brand.	Moisture %	Nitrogen %	Phosphoric Acid. Soluble %	Phosphoric Acid. Reverted %	Phosphoric Acid. Insoluble %	Phosphoric Acid. Total %	Phosphoric Acid. Available %	Potash %	Station Valuation. Value of nitrogen $	Station Valuation. Value of phosphoric acid $	Station Valuation. Value of potash $	Station Valuation. Total valuation $
1010	Bowker's Square Brand Bone and Potash	5.60	1.68	2.19	3.78	12.50	18.47	5.97	2.14	5.38	13.57	1.93	20.88
1004	" Sure Crop Bone Phosphate	13.25	1.02	8.80	1.50	2.85	13.15	10.30	1.48	3.26	16.44	1.33	21.03
947	Bradley's Complete Manure for Potatoes and Vegetables	11.10	3.55	6.84	2.15	1.94	10.93	8.99	6.30	11.72	14.04	5.67	31.43
873	" Eureka Seeding Down Fertilizer	9.10	2.30	3.12	2.25	6.55	11.92	5.37	2.26	7.36	10.45	2.03	19.84
857	" Potato Manure	12.55	2.75	3.95	2.02	2.56	8.53	5.97	5.04	8.80	9.77	4.54	23.11
858	Bradley's X. L. Superphosphate	12.10	2.79	7.04	2.78	2.29	12.11	9.82	2.14	8.93	15.37	1.93	26.23
863	Clark's Cove Bay State Fertilizer	13.70	2.54	6.58	3.19	1.48	11.25	9.77	1.92	8.13	14.93	1.73	24.79
848	" " " " G. G	13.25	2.34	7.04	2.99	1.79	11.82	10.03	2.10	7.49	15.47	1.89	24.85
879	Cleveland Potato Phosphate	13.18	2.27	7.23	2.11	1.96	11.30	9.34	2.91	7.26	14.57	2.62	24.45
878	Cleveland Seeding Down Fertilizer	10.65	1.82	4.39	2.15	4.59	11.13	6.54	2.10	5.82	11.43	1.89	19.14
880	Cleveland Superphosphate	13.20	2.28	6.82	2.48	2.35	11.65	9.30	2.26	7.30	14.64	2.03	23.97

RESULTS OF ANALYSES.

Station Number.	Brand.	Moisture %	Nitrogen %	Phosphoric Acid. Soluble %	Phosphoric Acid. Reverted %	Phosphoric Acid. Insoluble %	Phosphoric Acid. Total %	Phosphoric Acid. Available %	Potash %	Station Valuation. Value of nitrogen $	Station Valuation. Value of phosphoric acid $	Station Valuation. Value of potash $	Station Valuation. Total valuation $
889	Crocker's Corn Phosphate	11.45	2.21	7.04	2.22	2.47	11.73	9.26	1.75	7.07	14.66	1.57	23.30
1046	Concentrated Phosphate	5.20			32.93	12.55	45.48	32.93			51.12		51.12
849	Cumberland Superphosphate	12.55	2.48	6.60	2.71	2.19	11.50	9.31	2.19	7.94	14.57	1.97	24.48
917	" Potato Fertilizer	12.35	2.18	6.82	2.87	1.27	10.96	9.69	2.45	6.08	14.76	2.20	23.94
877	" Seeding Down Fertilizer	14.65	1.76	4.14	2.05	2.56	8.75	6.19	.05	5.63	10.10	.85	16.58
892	Dirigo Fertilizer	6.32	3.04	.63	.65	5.33	6.61	1.28	4.19	9.73	3.98	3.77	17.48
918	Farrar's Potato Fertilizer	12.85	2.75	7.06	2.47	1.77	11.30	9.53	4.44	8.80	15.69	3.99	28.48
919	Farrar's Superphosphate	13.30	2.57	6.93	2.22	2.37	11.52	9.15	2.06	8.22	14.45	1.85	24.52
887	Grass and Grain Fertilizer	10.75	.63	5.33	3.90	3.93	13.16	9.23	1.25	2.03	15.02	1.19	18.23
1039	Great Eastern General Corn Manure	14.32	3.01	3.61	5.61	.91	10.13	9.22	2.26	9.63	13.62	2.03	25.28
1040	" " " Potato Manure	14.30	2.45	3.68	5.84	.93	10.45	9.52	3.87	7.81	14.07	3.48	25.39

RESULTS OF ANALYSES.

Station Number.	Brand.	Moisture %	Nitrogen %	Phosphoric Acid. Soluble %	Phosphoric Acid. Reverted %	Phosphoric Acid. Insoluble %	Phosphoric Acid. Total %	Phosphoric Acid. Available %	Potash %	Station Valuation. Value of nitrogen $	Station Valuation. Value of phosphoric acid $	Station Valuation. Value of potash $	Station Valuation. Total valuation $
862	Great Planet Manure	11.00	3.45	6.05	2.03	1.48	10.16	8.68	6.78	11.40	13.40	5.42	30.22
999	Ground Bone and Potash	6.40	1.40		2.13	9.72	11.85	2.13	3.35	4.48	6.87	3.01	14.36
856	High Grade Amm. Bone Superphosphate	8.40	2.12	7.50	2.20	2.11	11.81	9.70	2.10	6.96	15.17	2.12	24.25
847	King Phillip Alkaline Guano	14.15	1.70	5.58	2.59	2.42	10.59	8.17	2.90	5.44	12.95	2.61	21.00
954	Mayflower Fertilizer	15.62	1.63	2.78	7.57	.90	11.25	10.35	1.59	5.22	15.12	1.43	21.77
955	New England Favorite	14.47	1.86	3.44	6.78	1.27	11.49	10.22	1.14	5.95	15.16	1.03	22.14
888	New Rival Amm. Superphosphate	12.70	1.31	5.96	2.64	3.22	11.82	8.60	1.55	4.19	13.91	1.39	19.49
1013	Nobsque Guano	13.90	1.29	6.33	2.25	1.65	10.23	8.58	2.47	4.13	13.30	2.22	19.65
984	Original Bay State Bone Superphosphate	11.27	2.87	2.05	5.41	3.66	11.12	7.46	4.07	9.18	12.10	4.21	25.49
978	Original Coe's Superphosphate	13.22	2.29	6.97	2.15	3.03	12.15	9.12	1.61	7.33	14.07	1.45	23.45
1005	Otis Superphosphate	13.35	2.87	6.84	2.90	2.30	12.04	9.74	2.31	9.18	15.24	2.08	26.50

RESULTS OF ANALYSES.

Station Number.	Brand.	Moisture %	Nitrogen %	Phosphoric Acid. Soluble %	Phosphoric Acid. Reverted %	Phosphoric Acid. Insoluble %	Phosphoric Acid. Total %	Phosphoric Acid. Available %	Potash %	Station Valuation. Value of nitrogen $	Station Valuation. Value of phosphoric acid $	Station Valuation. Value of potash $	Station Valuation. Total valuation $
953	Pilgrim Fertilizer	15.36	1.16	2.17	6.51	1.23	9.01	8.66	1.70	3.71	12.58	1.53	18.09
926	Potato Fertilizer, High Grade	10.10	2.26	5.54	2.00	2.05	9.59	7.54	5.13	7.23	11.98	5.39	24.55
890	Potato, Hop and Tobacco Phosphate	12.30	2.11	6.38	2.61	1.96	10.95	8.99	2.87	6.75	14.00	2.58	23.28
1021	Plymouth Rock Fertilizer	11.75	2.93	5.03	5.43	.70	11.16	10.46	3.52	9.30	15.42	3.57	28.37
881	Quinnipiac Phosphate	14.00	2.74	6.84	3.01	1.50	11.35	9.85	1.73	8.77	15.08	1.56	25.41
882	" Potato Manure	11.95	2.69	4.52	1.58	2.14	8.24	6.10	5.34	8.61	9.85	4.81	23.27
883	" Seeding Down Manure	14.50	1.20	6.41	2.10	1.84	10.35	8.51	2.12	3.84	13.29	1.91	19.04
936	Reeves' Potato Special Concentrated Manure	14.85	2.97	2.72	5.02	.55	8.29	7.74	8.45	9.50	11.05	7.00	28.15
899	Royal Bone Phosphate	15.00	1.26	5.87	2.15	2.16	10.18	8.02	2.20	4.03	12.67	2.03	18.73
893	Sagadahoc Superphosphate	12.50	2.81	6.92	2.10	1.19	10.21	9.02	3.00	8.99	13.80	2.70	25.49
871	Soluble Pacific Guano	14.50	2.36	6.83	3.43	.84	11.10	10.26	2.03	7.55	15.38	1.83	24.76

RESULTS OF ANALYSES.

Station Number.	Brand.	% Moisture	% Nitrogen	Phosphoric Acid. % Soluble	% Reverted	% Insoluble	% Total	% Available	% Potash	Station Valuation. $ Value of nitrogen	$ Value of phosphoric acid	$ Value of potash	$ Total valuation
993	Soluble Pacific Special Potato Manure	13.40	2.87	4.11	1.59	1.96	7.96	6.00	5.06	9.18	9.62	4.55	23.35
884	" " " for Tobacco and Potatoes	12. 0	2.25	7.25	2.22	1.78	11.25	9.47	3.13	7.25	14.69	2.82	24.71
1045	South Carolina Rock	1.00			1.52	23.82	25.34	1.52			11.66		11.66
891	Special Potato Fertilizer, Sagadahoc	11.50	2.84	5.17	1.81	1.00	7.98	6.98	7.86	9.28	10.68	7.36	27.32
925	Special Potato Fertilizer (Coe's)	8.80	1.78	7.01	2.09	2.21	11.31	9.10	3.46	5.70	14.32	3.66	23.68
864	Standard A Brand Seeding Down	10.60	1.29	6.01	2.68	2.23	10.08	7.85	1.49	4.13	12.30	1.34	17.86
850	Standard Fertilizer	13.90	2.34	5.17	2.93	2.11	11.65	9.54	2.07	7.48	14.85	1.86	24.19
866	" Guano	15.10	1.33	4.76	2.64	2.26	9.66	7.40	2.32	4.23	11.74	2.09	18.09
992	" Potato Fertilizer	13.55	2.14	7.32	2.30	1.48	11.10	9.62	2.62	6.85	14.79	2.36	24.00
969	" Superphosphate	13.70	2.65	6.54	3.19	1.71	11.44	9.73	2.07	8.48	14.95	1.86	25.29
1001	Stockbridge Manure for Corn	10.77	2.94	6.64	2.94	3.43	13.01	9.58	4.46	9.41	15.43	4.01	28.85

RESULTS OF ANALYSES.

Station Number.	Brand.	Moisture %	Nitrogen %	Phosphoric Acid. Soluble %	Phosphoric Acid. Reverted %	Phosphoric Acid. Insoluble %	Phosphoric Acid. Total %	Phosphoric Acid. Available %	Potash %	Station Valuation. Value of nitrogen $	Station Valuation. Value of phosphoric acid $	Station Valuation. Value of potash $	Station Valuation. Total valuation $
1032	Stockbridge Manure for Onions	10.50	3.50	5.83	2.50	2.62	11.00	8.33	5.89	11.20	13.87	5.90	29.87
851	" " " Potatoes	9.02	3.46	6.35	2.55	2.33	11.23	8.90	6.06	11.07	14.02	5.45	30.54
1002	" " " Roots	4.80	5.06	1.97	2.23	7.38	11.58	4.20	7.12	16.19	9.02	6.40	31.61
1024	" " " Small Fruits and Strawberries	8.25	2.51	6.14	2.24	3.59	11.97	8.38	9.36	8.03	13.79	10.22	32.04
982	" " " Top Dressing	4.45	4.99	1.28	3.66	7.48	12.42	4.94	5.95	15.97	10.03	5.35	31.35
1007	" " " Vegetables	10.15	3.70	5.01	3.09	2.56	10.66	8.10	6.69	11.84	12.85	6.01	30.70
1014	Sulphur and Tobacco Lawn Fertilizer	13.50	2.12			.88	.88		7.05	6.78	.33	7.75	14.86
854	Williams & Clark Potato Phosphate	12.07	2.85	4.85	1.73	2.38	2.38	7.17	5.43	9.12	9.89	4.89	23.09

OBSERVATIONS ON THE FERTILIZER INSPECTION OF 1892, AND REMARKS ON METHODS OF BUYING PLANT FOOD.

In the case of sixty-four brands of fertilizers analyzed, the average selling price as given to the Station Agent was $34.08. The average station valuation of the same brands was $24.07, or $10 less than the selling price.

The station valuation is the same for which the fertilizing ingredients in one ton can be bought in the large markets in a condition ready for use, consequently in 1892 it is costing the farmer $10 per ton or forty per cent. of the retail price in Boston, for instance, to have the goods placed at his door. Perhaps it may be said that some manufacturers are furnishing plant food more cheaply. In the case of seventeen brands sold by two leading manufacturers, the average selling price is $36.38 and the average station valuation $27.05, a difference of $9.33, or 34.5 per cent. of the cost in the market.

It appears then, that even with the manufacturers most largely patronized, there is a margin of over $9.00 between what farmers are actually paying for a ton of superphosphate and the cost of the same amount of plant food in unmixed goods when bought in the large markets. It certainly does not cost $9.00 for freight and mixing. The other items of expense are agents' commissions, credit, etc., and these might be saved by a change in business methods.

This subject has been extensively studied and discussed by the New Jersey Experiment Station, and the following admirable comments by Mr. Voorhees, chemist of the station, are of interest to farmers in general.

"The principal points which have been shown are—1. That the nitrogen, phosphoric acid and potash in raw or unmixed materials can be bought at a less cost per pound than the Station's valuations; and 2. That the cost of the same elements in mixed fertilizers is at least 25 per cent. greater than Station's valuations. The difference between these two methods of buying would amount on the basis of last year's sales to over $336,000. (For New Jersey.) This sum is consumed not in manufacturers' profits alone, as some suppose, but in the transportation of a vast amount of absolutely worthless material, in agents' commissions and in credit.

There are two classes of farmers who claim that it does not pay to buy the unmixed or incomplete materials: First, those who use very small quantities; and, second, those who act as selling and advertising agents. In the first case less favorable terms are quoted for unmixed materials, and the expenses of freight and handling are proportionately increased, thus adding materially to the cost of actual fertilizing elements. In the second case specific brands are bought direct from the manufacturer in large lots at low rates for cash, thus saving in freight, commission and credit upon personal supplies. The majority of farmers, however, especially those who make farming their sole business, do not belong to either of these classes, and hence these arguments lose their force, though not their influence, on such farmers as are not progressive and do not study closely the matter of economical buying. Still, if manufacturers would treat all buyers as they do their agents and sell to them direct, and farmers could be made to realize the importance of co-operation and of cash purchases, the trade in complete fertilizers would be more satifactory to both producer and consumer. Under present conditions, however, the evidence gathered by the Station is manifestly in favor of the buying of unmixed materials and applying direct, as needed, or mixing to suit the varied needs of crop and soil."

Among the causes which should receive emphatic mention as producing the high prices for mixed fertilizers sold by agents, is the credit system, and for this the farmer is himself largely responsible. A cash system would make a saving of so large a per cent. of the cost of fertilizers as to render it profitable for farmers to hire money at six per cent. in order to pay down for their goods. Still further advantage would be secured by co-operation in the buying of large quantities.

Unmixed fertilizers such as plain superphosphates, nitrate of soda and muriate of potash have been mentioned as furnishing plant food more cheaply than the mixed goods, but this is not necessarily the case. It so happens that the former materials are the ones which can be purchased without the intervention of the travelling and local agents, whose interests must be protected by the manufacturer, and these are the goods to which the more economical method of buying can more easily be applied. As Mr. Voorhees suggests, the common brands of superphosphate could doubtless be obtained on just as favorable terms, provided a change could be made to direct sales of large quantities for cash.

If farmers would give this matter immediate practical attention, they would be more certain to secure prompt and important financial advantages than by the long drawn out discussions over tax and tariff reforms, however important these may be.

The disadvantages of the present method by which our farmers are largely obtaining their fertilizers may be summarized as follows:

(1) It is a costly system of selling due to the large expense for agents and the great loss on credits.

(2) It is a system which unfortunately seems to be accompanied by so many unfair arguments and so much of distortion of facts that the farmer is, to some extent, hindered rather than aided in gaining clear ideas of true facts.

(3) And so this is a system which leads farmers to consider chiefly the rival claims of competing manufacturers rather than to study his own needs and then to buy such plant food as is adapted to his wants.

If farmers are to purchase commercial plant food, great advantages would result in a change to the following system:

(1) The buying of plant food as such under proper names, and thus avoid the confusion and uncertainty attending the purchase of an ever increasing number of brands whose names mean little or nothing.

(2) The purchase of fertilizers in large quantities for cash.

MISCELLANEOUS ANALYSES.

835. *Muck* from I. O. Winslow, St. Albans.

841 and 842. *Mucks* from E. E. Light, Burkettsville.

	835		841		842	
	Original condition.	Water-free.	Original condition.	Water-free.	Original condition.	Water-free.
Water	77.52	——	80.66	——	79.54	——
Ash and Sand	4.30	19.15	1.49	7.70	7.04	34.43
Potash	.03	.14	.02	.08	.04	.20
Phosphoric Acid	.24	1.08	.10	.54	.19	.96
Nitrogen	.38	1.70	.42	2.16	.34	1.67

When received at the station samples of muck contained so much water that it is necessary to dry them before they can be properly pulverized for analysis. The results obtained are recalculated for the original content of water and also, for purposes of comparison, to a water-free basis. The first figures are, of course, of most interest to the farmer, as they represent more nearly the condition of the muck as it is ordinarily used for agricultural purposes.

672. *Feldspar.*—From Cumberland Bone Co. Potash 12.07 per cent. A typical orthoclase feldspar may contain as high as 16.9 per cent. potash. Here, as in most feldspars of the orthoclase variety, a part of the potash is replaced by soda.

676. *Fish Pomace.*—From P. B. Friend, N. Sedgwick. This is said to consist for the most part of the heads of herrings, from a sardine factory. It contains: Water 54.66 per cent., Nitrogen 5.26 per cent., Potash .26 per cent., Phosphoric acid 2.05 per cent.

684. *Sea Weed.*—From H. A. Long, Gt. Beach, Roque Island. Water 76.00 per cent., Nitrogen 1.04 per cent., Phosphoric acid .07 per cent.

834. *Cedar Ashes.*—From Judge Robinson, Houlton. Water 1.52 per cent., Potash 5.09 per cent., Phosphoric acid 1.91 per cent.

843. *Ashes from Burned Muck.*—From Albert Pease, Phillips. This material is largely siliceous, about 95 per cent. being insoluble in hydrochloric acid. It contains traces of phosphoric acid, but not enough to give it any value.

ANALYSES OF CATTLE FOODS.

Certain cattle foods have been sent to the Station for analysis from time to time, the composition of some of which is given below.

CXXXVI. Linseed Meal, sent by Hon. Z. A. Gilbert.

CXXXVII. Feed Flour, " " " " "

CXXXVIII. Flour Sweepings, sent by E. F. Roundy, North Hermon.

CXXXIX. Flour Sweepings, sent by E. F. Roundy, North Hermon.

CXXIII. Pratt's Food, sent by A. C. Chandler, New Gloucester.

Station Number.		Air dry.						Water-free.				
		Moisture.	Ash.	Protein N x 6.25.	Fiber.	Nitrogen free extract.	Fats.	Ash.	Protein N x 6.25.	Fiber.	Nitrogen free extract.	Fats.
CXXXVI	Linseed Meal...	9.03	5.60	39.94	7.28	35.27	2.88	6.15	43.94	8.00	38.77	3.15
CXXXVII	Feed Flour......	7.32	2.82	20.81	1.93	62.44	4.68	3.04	22.44	2.08	67.38	5.05
CXXXVIII	Flour Sweepings	11.33	2.50	10.62	1.89	72.03	1.63	2.82	11.98	2.13	81.23	1.84
CXXXVIX	" "	8.80	15.95	9.19	1.50	59.35	5.21	17.49	10.07	1.64	65.09	5.71
CXXIII	Pratt's Food....	12.36	5.79	13.75	5.94	56.80	5.36	6.60	15.69	6.77	64.83	6.11

The above analyses of cattle foods call for no special comment with the exception of Pratt's Food for horses and cattle. There are several weighty reasons why this food should receive careful consideration.

(1) It is sold at the rate of $120 per ton.

(2) Its manufacturers claim that it prevents nearly all of the common diseases and disorderes to which farm animals are subject, that it is, besides, a preventive of certain serious contagious diseases, that it produces richer milk and more of it, that animals fatten quickly when it is fed, and that it gives to horses greater power of endurance.

If the manufacturers of this material have succeeded in combining a food that in its relation to disease has such a high preventive and remedial influence, and in its relation to the nutrition of an animal produces the highly valuable results which appear to be claimed by their circulars, they should be classed among the benefactors of the age. It must be confessed, however, that the advertised claims of this food exceed the credible and pass into the absurd.

This becomes all the more evident when we consider what the food is. It has received a careful examination at this Station, and while we are not prepared to say that it does not contain minute quantities of substances which we have not discovered, we have become convinced that its composition does not warrant its purchase at any unusual price. The results of our examination are as follows:

(1) The food has the appearance of being chiefly ground bran or shorts and is undoubtedly what it appears to be.

(2) The food contains a small amount of fenugreek, an aromatic seed supposed to have mild medicinal properties.

(3) It contains something less than three per cent. of common salt.

(4) The quantities of any other substances which it may contain are so small as to not be easily discovered. It is the opinion of those examining the food that no other compounds exists in it save those which are the proper constituents of any food.

(5) The analysis of the food gives about the same figures that we should expect from bran or shorts, with a somewhat smaller percentage of protein than these milling products now contain.

Even if it were found that this food is so compounded as to have, under certain circumstances, a positive medicinal effect, this fact would not constitute a good reason why farmers should purchase and feed it indiscriminately. We no longer believe in quack nostrums that will cure all troubles. The course which the intelligent farmer takes to-day in the treatment of diseased animals is to secure the attendance and advice of a competent veterinarian who will administer remedies suitable to the case in hand. As for the prevention of disease it is a common experience that all that is ordinarily necessary is cleanliness, good care and proper and sufficient food. If these conditions do not prevail it is useless for the farmer to attempt to remedy the faults in his management by the use of any advertised cure-all, such as the one under consideration. This food may not possess any injurious properties because of the small amount of unusual constituents which it contains, but in the opinion of the writer its purchase at a price exceeding the ordinary cost of commercial cattle foods is a waste of money.

PRELIMINARY NOTES ON THE SECONDARAY EFFECTS OF POLLINATION.

By W. M. Munson.

The change produced by contact of embryo sac and pollen tube is not confined to the mere vivification of one or more cells; though this is the chief end,—the primary object of all pollination. There are certain secondary effects which are of interest to the botanist and may be of great practical value to the horticulturist.

When there is a difference between male and female parents, the embryo partakes to a greater or less extent of the nature of both parents. In general, this influence is apparent first in the offspring of the cross; but in some instances there appears to be an immediate effect on the ovary or other portions of the female parent. In some cases also, the pollen seems to have a direct stimulating influence on the ovarium, without effecting the impregnation of the ovules. Again, in certain instances the vigor of the plant seems sufficient to develop a marked growth of the ovary in the entire absence of the male element. The form and size of the ovary are often materially affected by the application of different amounts of pollen to the stigma. In some plants more than one embryo is developed in a single ovule, indicating the possibility of superfœtation. These, and other secondary problems arising in connection with the systematic amelioration of cultivated plants, are often of great practical importance.

The following notes can be regarded only as preliminary; as forming a basis from which to start in future work in this direction. Although some of the problems considered have been under discussion for more than a century, they are still unsolved. There has not been sufficient systematic study to warrant the formulation of general laws, and this study must necessarily extend over a long series of years. In the notes are embodied as concisely as may be, the more important results obtained by leading experimenters in this country and in Europe, together with some observations of the writer on the subjects in question.

Special acknowledgement is due to Professor L. H. Bailey of Cornell University, for the use of certain notes and photographs, and for free access to his private library.

I. ON THE IMMEDIATE INFLUENCE OF POLLEN ON THE MOTHER PLANT.

Even before the sexual theory regarding plant reproduction was commonly accepted, the question of the immediate effect of pollen on the form and character of the female parent received the attention of careful observers. Bradley early gave directions for performing the operation of crossing and wrote: "By this knowledge we may altar the property and taste of any fruit by impregnating the one with the farina of another of the same class; as, for example, a Codlin with a Pearmain, which will occasion the Codlin so impregnated to last a longer time than usual and be of a sharper taste; if winter fruit be fecundated with dust of the summer kinds, they will decay before their usual time."*

In 1745 Benjamin Cook, in a paper before the Royal Philosophical Society,† cited the appearance of russet apples on trees ordinarily producing smooth fruit, and the reverse, as examples of the effect of pollen. Other cases have been frequently noted as proofs of the existence of the same phenomenon.‡ Even at this early date, however, careful experiments undertaken by Thomas Andrew Knight and others, tended to show that the apparent effects might be due to bud variations, or other causes aside from the action of pollen. Knight at this time wrote: "I have in some hundred instances introduced the pollen of one variety of the plum, the pear, the apple, the cherry, the peach, the melon and other fruits into the blossoms of very different and opposite habits, and I have never, (although I have most closely attended to the results) found in any one instance the form, colour, size or flavour of the fruit belonging to such blossoms in any degree whatever changed or affected."§

In 1865 Thomas Meehan opened discussion of the subject in the columns of the Gardener's Monthly, remarking: "For ourselves, without being satisfied that there is any material change in the quality of the fruit, we cannot deny there is some; and there may be much more than we at present imagine. At any rate, we think it may be taken for granted that melons grown near squashes often have a suspicious squashy flavour, that gives some ground for the popular theory of mixing."‖ The suggestion is further made that if the change be found to occur in squashes, the same law will apply to the whole region of fruit—an assumption which is altogether too broad.

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* Bradley, New Improvements in Planting and Gardening, 7th ed. (1739), p. 18.
† Philosophical Trans. 1745.
‡ Trans. Lond. Hort. Soc., V, 65.
§ Trans. London Hort. Soc., V, 67.
‖ Gard. Month., VII, 306.

There is evidence which goes to show that within certain limits there is an immediate effect of the male element, but that those limits are quite restricted. As early as 1729 the presence of both white and blue peas in the same pod was observed, when two varieties of the different colors were planted near each other.* This fact has been repeatedly confirmed. In 1822 examples were presented to the London Horticultural Society. A variety known as Blue Prussian was crossed with a white variety. The resultant peas were yellowish-white like the male parent.† Laxton, in 1866, crossed the Tall Sugar Pea which bears thin green pods, with pollen of a purple-podded variety. "The pod resulting was clouded with purple, while one of the peas was of a clear violet-purple tint and another was irregularly clouded with purple." The results, in so far as the changed color of the peas is concerned, were confirmed by Darwin.‡

Crucknell§ cites an instance of apparent immediate influence in case of the pear. A single branch on a Belle Lucrative tree bore a few specimens resembling Vicar or Winkfield. As Vicars were growing near, the conclusion is drawn that the fruits in question were affected by the foreign pollen. There is no reason to suppose, however, that this and the numerous cases of the appearance of russet apples on trees not usually russeted, are other than instances of bud variation, as pointed out by Knight.‖

Of about one hundred artificial pollinations performed by Charles W. Garfield at the Michigan Agricultural College, but three of the crosses showed any variation which could in any way be construed as the effect of pollen. "These were: *First.* Wagener upon Tallman Sweet. There was a modification of flavor quite noticable, the fruit being sub-acid. *Second.* Tallman Sweet upon Astrachan. In this instance there was a manifest change in the color, flavor and shape. The apples were quite mild to the taste, the color was very much modified, and the form was that of a flat apple. *Third.* Tallman Sweet upon Wagener. The modification here was noticable in all the specimens, in flavor and color."* I am informed, however, that at the present time Mr. Garfield doubts the influence of pollen in causing the variations here noted.

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* Philosophical Trans., XLIII, 525.

† Trans. Hort. Soc., V, 234.

‡ An. and Plts. Under Domest., I, 428.

§ Gard. Month., IX, 165.

‖ Trans. London Hort. Soc., V, 67.

Professor L. H. Bailey in 1887, performed many crosses with different varieties of apples "and got no effect in any way, not even in season of maturity or in texture."† Similar results were obtained by Crozier in 1888. More than one thousand crosses were made, and they were carefully observed during the season with a view to detecting any immediate effects. "The examination failed to show any differences which could be attributed to the influence of the cross. In several instances different varieties were crossed upon the same tree, but the resulting fruits did not differ materially from each other, or from the remainder of the crop upon the tree."‡

In many species, both wild and cultivated, sports bearing fruit differing from the normal type, are not uncommon. Diœcious plants of this character must necessarily receive pollen from an individual of a different character, but as a rule no effect is observed on the appearance of the fruit of either individual. A single plant of *Mitchella repens*, bearing white berries, was discovered by Mr. Meehan and removed to his grounds. Thus isolated, it produced no fruit, but in the natural state, and fertilized by pollen from the red-berried form, the white fruit was produced in abundance. *Ilex verticillata* as a rule has red berries, but a white-berried form on the grounds of Professor Sargent regularly produced white fruit, although necessarily receiving pollen from the red form.§

On the other hand, instances are cited to show that there is a marked effect on the color of flowers when two varieties of different color are in close proximity. White verbenas, growing by the side of a pink variety are said to have produced striped flowers on the side of the plant next to the pink variety—the other side of the plant retaining the white color.‖ Similar instances of changed color in case of phlox and petunias have come under my own observation, but in each of these cases the plants were so situated that the change could not be construed as due to the influence of pollen.

If pollen exerts a modifying influence on the character of the fruit, we should expect the color of black grapes to be less intense if fertilized by pollen from white varieties, than if self-fertilized, or crossed by other dark varieties. That such influence is doubtful, however, is indicated by the work of Goff, of Crozier and others.

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* Gard. Month., XVIII, 23, (Jan., 1876.)
† Proc. Am. Pom. Soc., 1887, 22.
‡ Crozier, Bul. 3, Iowa Agr. Expt. Sta., 92.
§ Gard. Month., XXVII, 116.
‖ Berckmans, Am. Agriculturist, July, 1889, 344.

In 1886, Goff crossed several varieties of black grapes with pollen from a white variety—the Lady Washington. Other flowers on the same vines were self fertilized. At maturity it was impossible to detect any difference either of color or of flavor between the self-fertilized and the crossed berries of the same variety.[*] Similar results were obtained by Crozier at the Iowa Experiment Station in 1888.[†]

The cotton plant furnishes an instance in which there is apparently unmistakable evidence of the immediate effect of foreign pollen. In 1890, at the Georgia Experiment Station, flowers of upland cotton, *Gossypium Barbadense*, were crossed with pollen from common Okra, *Hibiscus esculentus*. Apparently perfect bolls of cotton were formed, but in every instance the seed failed to germinate when planted. The reciprocal cross resulted in apparently normal Okra seeds, but the offspring varied from the normal in time of flowering and fruiting.[‡] In 1891 the work was repeated, and Director R. J. Redding in a private letter to the writer reports, "bolls of cotton, the result of cotton blooms pollenized with Okra pollen this year, in which one and sometimes two of the carpels contained a very small quantity of lint adhering to the seed while the other divisions of the ovary were abortive."

It was early observed[§] that there is an immediate visible effect of foreign pollen on corn, extending in many cases even to the receptacle, and the repeated confirmations by Crozier, Sturtevant,[‖] Kellerman,[¶] Tracy[**] and others would leave little doubt as to the accuracy of the observations.

That there is a difference in varieties, in the readiness with which the influence of pollen is shown, is altogether probable. Sturtevant lays down the general proposition: "Under the conditions of ordinary seed, maize does not in general show the effects of current cross-fertilization, the exception being the sweet corns which exhibit the influence of current foreign pollen very readily."[††] The proposition is based on the study of about one hundred and twenty-five named varieties, including flint, dent, pop, and sweet corns. That the flint and dent varieties often exhibit a change the current year, however, is abundantly proved by the work of the other experimenters referred to; though all agree that the change is most readily seen in sweet corn, and least so in the flint varieties. In this connection, also, Sturtevant makes the statement that "cross-bred corn has a greater tendency to current cross-fertilization than has purely bred corn"[*]—a condition we should naturally expect from the variable tendency of hybrids and cross-breeds. While there would seem to be no doubt as to the immediate influence of foreign pollen in the case of corn, it is not improbable that what is in reality seminal effect, may sometimes be credited to the immediate action of the foreign pollen.

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[*] 5th Rep. N. Y. Agr. Exp. Sta., 180.
[†] Agr. Sci., II, 319.
[‡] Expt. Sta. Record, III, 135.
[§] Philosophical Trans., XLVII, 206.
[‖] 3rd Rep. N. Y. Exp. Sta., 148.
[¶] 2nd Rep. Kan. Exp. Sta., 288-335, (1889).
[**] Rep. Mich. Hort. Soc., 1888, 43.
[††] 3d Rep. N. Y. Ag. Exp. Sta., 149.

Darwin cites numerous instances[†] to prove the existence of an immediate effect of crossing and though some of the examples to which he gave credence are now discredited, many of them are apparently well authenticated.

Seeds of *Matthiola annua* are normally of a light brown color, while those of *M. incana* are violet black; yet *M. annua* crossed by *M. incana* yielded about fifty per cent. of black seeds. Flowers of the orange fertilized by pollen from a lemon tree produced fruit bearing a longitudinal stripe of peel having the color, flavor and other characters of the lemon. Recent observations in this country and in Europe would appear to confirm the statements regarding citrus fruits.[‡] Sabine[§] cites an instance in which the form of the ovary of *Amaryllis vittata* was altered by the application of foreign pollen; while Maximowicz made reciprocal crosses between *Lilium bulbiferum* and *L. davuricum* and found "each species produced fruit almost identical with the pollen bearing species."[‖] Fritz Müller crossed *Cattleya Leopoldi* by *Epidendron cinnabarianum*, and obtained a marked change in the form of the seeds.[¶]

Rhododendron dalhousiæ crossed by *Rhododendron Nutallii* is cited by Darwin as an example of the increased size of ovary resulting from the action of foreign pollen, while *Arabis blepharophylla* crossed by *A. Soyeri* produced pods larger than either parent species.[**] Darwin also gives credence to the story of the St.

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[*] 3rd Rep. N. Y. Ag. Exp. Sta., 149.
[†] An. and Plts. Under Domest., I, 428 et seq.
[‡] See Repts. Am. Pom. Soc., 1889 and 1891.
[§] Trans. Lond. Hort. Soc., V, 69.
[‖] Darwin, An. and Plts. Under Domest., I, 431.
[¶] Ibid.
[**] Ibid, 432.

Valery apple, the stamens of which are abortive, and being artifically pollinated, the fruits are said to differ from one another in size, flavor and color, resembling in character the various kinds by which they have been fertilized.*

In the cultivation of pistillate varieties of strawberries, it is usually considered necessary to set some variety with well developed stamens in the immediate vicinity to furnish the pollen requisite to the fertilization of seeds, and consequent development of the receptacle. It is believed by many growers that the character of these pistillate varieties may be varied at will, by using different varieties for the male parent. In other words, it is believed that there is an immediate effect of the male element in determining the time of maturity, the color, the shape, and even the flavor of the receptacle of the variety crossed. If this theory be based on fact, it is of no small practical importance. If it were true, that in all cases, or that as a rule, the fruit partakes of the character of the male parent, there could be no fixed character to any pistillate variety. But will the facts warrant the assumption that this immediate effect in the case of strawberries is by any means universal, if common? Personally I have conducted no work bearing upon this point, but several experiments have been performed by careful observers, and the results obtained by them are of interest in this connection. The results as published differ considerably, but in general, the weight of authority goes to show that the receptacle is not materially affected by the male element.

At the meeting of the American Pomological Society in 1885, extended and spirited discussions of this subject were held. Professor W. R. Lazenby of the Ohio Experiment Station, had found the influence of the male element decidedly manifest. When blossoms of Crescent were fertilized by pollen from Downing, Vick, or Sharpless, the characteristic shape, texture and other qualities of the male used, were impressed on the receptacle to such an extent that it was possible to determine the male parent from the general appearance of the crop.† A repetition of these experiments the following season, however, failed to give any marked results.‡

A. S. Fuller who has made a careful study of the subject since 1859, claims to have obtained very marked indications of an immediate directing influence on the form and size of the receptacle.* Mr. Fuller attributes this apparent influence to the direct action of the pollen in stimulating the growth of ovary or receptacle without reference to the fertilization of the ovules. Admitting the stimulating effect, however—and of this there seems to be but little doubt—does the directing effect necessarily follow?

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* Darwin, An. and Plts. Under Domest I, 432.
† Proc. Am. Pom. Soc., 1885, 66.
‡ Rep. Ohio Exp. Sta., 1885, 107.

From an extensive field experiment conducted by Professor T. J. Burrill in 1884, it was found "easy enough to select individual berries conspicuously different from each other, as is always the case, but it was not possible to detect the slightest tendency towards a resemblance to the pollen bearer."† In a similar experiment conducted the following year on the farm of P. M. Angur of Connecticut, like results were obtained.‡

In none of the carefully conducted experiments of Goff and Hunn at the New York Experiment Station, have any immediate effects been discerned. Berries from Crescent blossoms, receiving the pollen of Lennig's White, were not different in color from those fertilized with Wilson or Sharpless pollen. Flowers fertilized on one side by pollen from the white variety, and on the other with Sharpless pollen were symmetrical in form and uniform in color.§ Out of one hundred and sixty-seven successful crosses made by Crozier, there was not an individual instance that pointed to a specific influence of the foreign pollen.||

The nature of cucurbitaceous plants is admirably adapted to show the immediate effects of crossing if such occur. In a mixed plantation many of the flowers on any individual plant, when left to natural processes, would necessarily receive pollen from very different sources. If now, there were an immediate effect of pollen, we should expect to find fruits of very different character on any vine. Such is not the case, however. I have repeatedly looked for this difference, but have never seen it; nor have I observed it when several flowers on the same plant were artificially crossed with pollen from different varieties or species. Crozier¶ and Bailey have repeatedly obtained like results. Bailey, whose crosses of cucurbits run up into the thousands, asserts positively that: "There is no immediate influence whatever, except such as is due to imperfect development caused by insufficient or impotent pollen."*

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* Proc. Am. Pom. Soc., 1885, 68.
† Proc. Am. Pom. Soc., 1885, 67.
‡ Ibid, 70.
§ 4th Rep. N. Y. Agr. Exp. Sta., (1885), 227; 5th Rep. (1886), 179; also Bul. 24, (N. S.), 330, (1890).
|| Agr. Sci., IV, 287.
¶ Ag. Sci., I, 227.

In our work with tomatoes and egg plants there has in no case occurred an instance of immediate effect, other than alteration of form due to insufficient pollen. During the past winter numerous crosses and hybridizations of tomatoes have been made. The accompanying photographs of the most violent of these crosses indicate the entire absence of apparent effects.

Figure 1 represents the "Lorillard," crossed by pollen of the "Currant," (*Lycopersicum esculentum* crossed by *L. Pimpinellifolium*). The Lorillard is a smooth, nearly spherical variety, of medium size, and as grown under glass, seldom weighs more than three or four ounces.

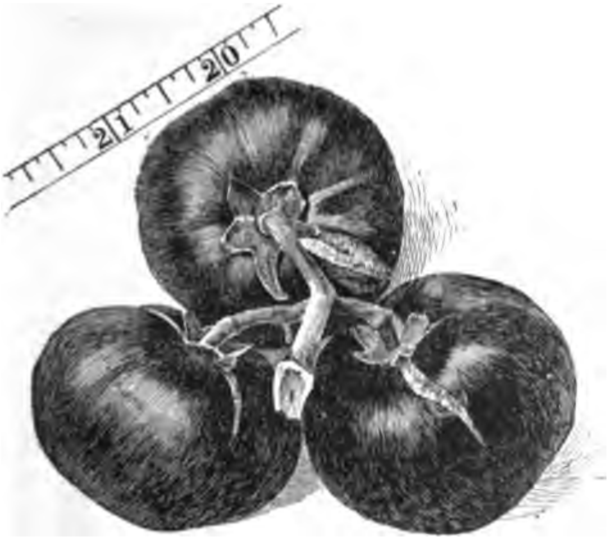

Fig. 1. *Lorillard* × *Currant.*

As will be seen, the fruit is in every respect typical of the Lorillard. The offspring from this cross, however, show unmistakable evidences of the influence of the male parent, both in the habit of the plants and in the character of the foliage and flowers. The fruit also is intermediate between the parents in size and character.

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* Bul. 25 Cornell Univ. Exp. Sta., 181, (Dec., 1890).

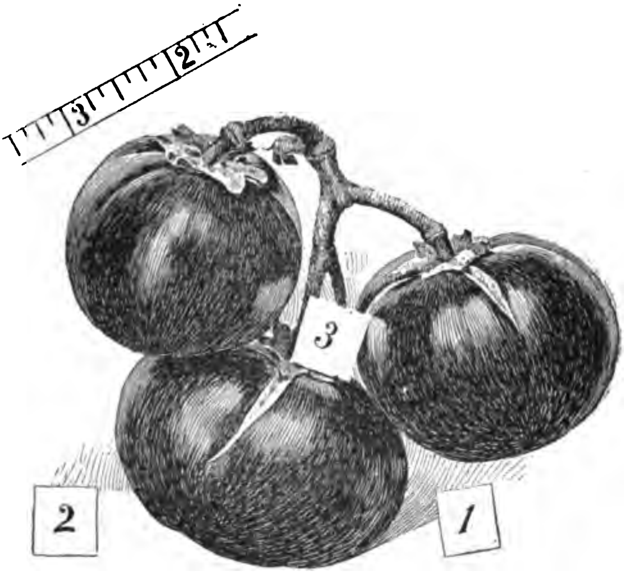

Fig. 2. *Lorillard × No. 1 Lorillard; No. 2, Currant; No. 3 Peach.*

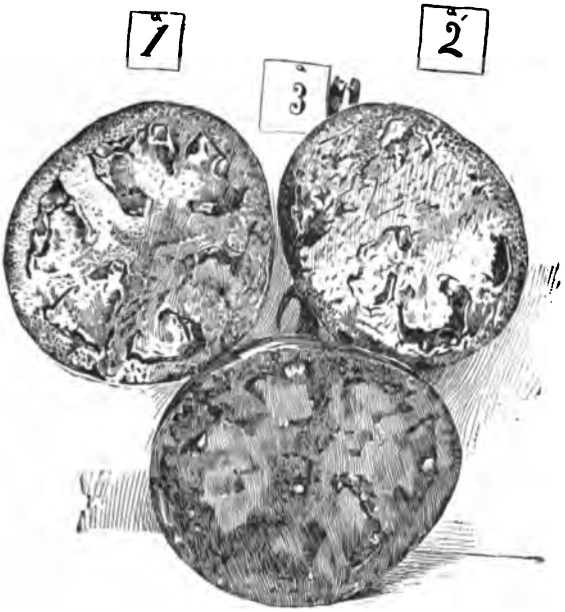

Fig. 3. *Section of Fruits shown in Fig. 2.*

Figures 2 and 3 are from photographs of a cluster in which each fruit has a different male parent. The variety used was the Lorillard. Number 1 received pollen of the same variety, while number 2 was given pollen from the "Currant," and number 3 from the "Peach." As in the previous instance, there is no apparent effect on the form of the fruit; and the seeds gave no indication of the different parentage—all were apparently typical Lorillard seeds.

In the offspring, the differences are very marked. The lines are sharply drawn between the crosses with Peach and Currant, the influence of the respective male parents being very evident, while the Lorillard cross is apparently unaffected by either of the others; indicating that there was no error in the operation, also that there has been no transfer of influence along the short peduncles, as suggested by Lowe.*

In an extended series of experiments with egg plants, conducted for three consecutive years at the Cornell University and the Maine State College, the most widely varying types have been crossed. In no instance, however, has there appeared an immediate effect of the male parent. The little Round White when crossed with pollen from Black Pekin, differed in no respect from other fruits on the same plant. But the offspring of this cross showed very marked variations. The same facts were observed regarding several other crosses.†

As before noted, instances have been reported in which the color of flowers was apparently changed by the action of foreign pollen the current season. An instance of such change has never come under my observation, though I have made numerous crosses of different varieties of Tropæolum, Fuchsia, Silene, Phlox, Petunia, and other ornamental plants.

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* See page 54.

† Bailey and Munson, Experiences with Egg Plants, Bul. 26 Cornell Ex. Sta., p. 14.

As indicating the range over which the study of the subject has extended, a partial list of the species considered by different observers is given.

Species in which immediate influence of pollen is said to have been observed:

Amaryllis vittata
Arabis blepharophylla
Cattleya Leopoldi
Citrus aurantium
Gossypium Barbadense,
Lilium bulbiferum
Lilium davuricum
Matthiola annua
Phaseolus vulgaris
Pisum sativum
Rhododendron dalhousiæ
Verbena -sp.
Zea Mays

Species in which no immediate effect appears to occur:

Cucumis melo
Cucumis sativus
Cucurbita maxima
Cucurbita moschata
Cucurbita pepo
Datura Stramonium,
Datura inermis
Fragaria Virginiana
Fuchsia sp.
Lycopersicum esculentum
Mitchella repens
Prunus Americana
Prinos verticillatus,
(Ilex verticillata, Gray)
Pyrus malus
Pyrus Torringo
Pyrus Soulardi
Vitis labrusca
Petunia violacea
Phlox Drummondii
Silene armeria
Solanum melongena
Tropæolum minus

The above lists are doubtless incomplete, and in any case they must necessarily be regarded as tentative. In some of the cases cited, however, the evidence seems indisputable. As will be observed, thirteen species belonging to twelve genera in ten distinct natural orders have shown variation supposed to be due to the influence of pollen of the current generation. On the other hand, twenty-two species belonging to fifteen genera in ten natural orders, have failed to show immediate effects. Of the thirteen species showing immediate influence of pollen, four—the orange, the bean, the pea and Indian corn—are of much value as food plants; while eleven species, or one-half of the whole number considered which have not shown this influence, are also important food plants. These eleven species include many of the leading fruits and vegetables, such as the apple, plum, strawberry, grape, tomato, egg plant, pumpkin, squash and melon. The strongest evidence both for and against the proposition is obtained from these species of economic importance; but the question is still an open one.

As yet there are no satisfactory data on which to base general conclusions. It would be unwise, at the present time, to assert that the directing influence of pollen does or does not as a rule extend beyond the fertilization of the seed. It seems not improbable that pollen from a vigorous plant may make an imprint of its character on the female organism which shall be different from that of a less vigorous male parent. It is probable, however, that the vigor and inherent vitality of the plant operated upon usually determines whether this be manifested. Some species show apparently unmistakable evidences of the influence of foreign pollen—this is notably the case with peas and Indian corn. On the other hand cucurbitaceous and solanaceous plants seem to resist all foreign influence; while rosaceous plants are in dispute, with the weight of authority tending to show the absence of immediate influence.

II. ON THE DEVELOPMENT OF THE OVARY WITHOUT FECUNDATION OF THE OVULES.

A common, though not an universal law of reproduction by seed requires fertilization of the ovules as a condition necessary to the development of fruit. It is a matter of common observation that, as a rule, when pollination fails to result in fertilization, or when pollen is withheld, not only the pistil withers, but the entire flower decays and falls. (Pollination is used in the sense of cöition in the animal kingdom, and does not necessarily result in impregnation). Instances are not infrequent, however, which point to a responsive action on the part of the pistil or other portions of the flower receiving pollen, while from an insufficient quantity of pollen, lack of affinity on the part of the species crossed, or some other cause which remains to be determined, fertilization does not occur. Examples of this are specially common in all of our cultivated fruits and vegetables.

About the close of the seventeenth century (1691), Camerarius had observed that a female mulberry tree once bore fruit though no male tree was in its vicinity. The fruits, however, contained only abortive seeds. Plants of *Mercurialis annua* being then brought under observation, it was noticed that while the fruits were abundant and well filled out, they began to wither when about half ripe and not one produced perfect seed.[*]

The instance of the mulberry is confirmed by Claypole who cites[†] a case within his own observation in which a pistillate tree bears fruit abundantly every year though no staminate tree is in the vicinity, and no staminate flowers have been found on the tree itself. The "seeds" in these fruits, as in the other instances, contain no embryos. Whether this is a case of development in the entire absence of pollen, as circumstances would indicate, or whether there may have been a limited supply of pollen at hand, it is evident that the ovaries developed independently of any action on the ovules.

Dr. Masters is authority for the statement that certain varieties of pears habitually produce seedless and coreless fruit.[‡] In the same way it is not uncommon to find the capsules of many herbaceous plants fully developed while the seeds are absent. M. Jean Sisley, a well known French horticulturist, found this to occur with great frequency in case of the geraniums and pelargoniums. Of one hundred flowers of *Geranium platypetalum* artificially pollinated, not one produced perfect seeds, and of a large number of capsules sent by another party, nearly all were without seeds.[§]

Naudin, as a result of his studies of the genus *Cucurbita*, suggested the possibility of a specific effect of pollen in exciting growth of the ovary; and this theory is supported by Focke, who says: "Pollen has two actions on the female organs, one on the seeds, and one in exciting the growth of the fruit."[||] The theory seems plausible, and in view of the many examples of well developed but empty seed pods, it would seem that the stimulating action is alone exerted in some instances. These examples are specially common among peas and beans.

The accompanying photograph, Figure 4, represents the natural size of a Lima bean which failed to develop seeds—the undeveloped ovules may be seen at the right. Similar instances are very common in all varieties of this class.

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[*] *R. J. Camerarii Opuscula Botanici Argumenti*, cited by Sachs, Hist. of Bot. 386.

[†] Rep. U. S. Dept. of Ag. 1887, 318.

[‡] Nature, XXXV, 12. (Nov. 4, 1886.)

[§] Gard. Chron. N. S. IV, 634.

[||] Focke, Die Pflanzen mischlinge, 447.

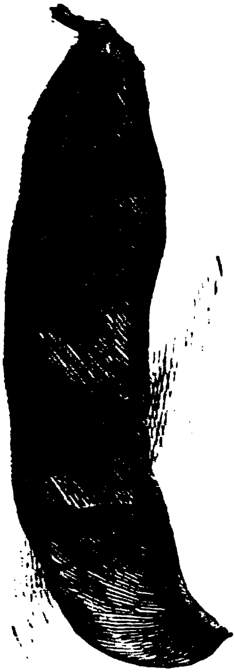

Fig. 4. *Lima Bean, Seedless, (Natural Size.)*

According to Hildebrand,* in the case of several orchids the plant's own pollen is necessary for the development of the ovarium; and this development takes place long before the pollen tubes have reached the ovules. So in these cases the pollen acts directly on the ovarium.

Disregard of the fact discovered by Camerarius, but not emphasized by him, that certain diœcious plants occasionally have monœcious individuals, has lead to many erroneous statements regarding the influence of the male element on the ovary. Hemp and Spinach have been cited† as examples of development without fertilization. It is well known, however, that both of these species have monœcious individuals, thus furnishing a source of error in observation. The Muskmelon, *Cucumis melo*, is another instance in point. This fact first attracted my attention when attempting to perform some artificial hybridizations between *Cucumis melo* and *Cucumis sativus*. The female blossoms on the variety under consideration, "Emerald Gem," were found to bear partially developed stamens. These stamens varied in size and in the amount of pollen produced, but subsequent developments indicated that enough pollen may be produced to secure self-fertilization. At the Cornell University Experiment Station several blossoms of this variety from which foreign pollen was excluded developed apparently normal fruits. In these cases of probable self-fertilization, however, there were no perfect seeds.

Darwin cites, on the authority of Dr. Hooker, an instance of the development of the ovarium of a certain orchid—*Bonatea speciosa*—as a result of simple mechanical irritation of the stigma.‡ So far as I am aware, this observation has never been verified, and it is questionable, in view of the facts here considered, whether the development would not have been as complete in the absence of the irritation.

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*Botanische Zeitung, No. 44 et. seq. Oct. 30, 1863, and Aug. 4, 1865—cited by Darwin, An. and Plts. Under Domest. I, 434.

†Le Maout and De Caisne, System of Botany, 152; also Spallanzani, quoted by Sachs, Hist. of Bot. 424.

‡An. and Plts. Under Domest, I, 434.

The fact that in growing English forcing cucumbers for market, gardeners never practice artificial pollination, as is necessary with the varieties commonly grown in this country, raised the question as to whether any pollen is required, and what proportion of the fruits would develop without fertilization. Several different varieties have been under consideration at different times. In case of the "Telegraph," a long slender variety, more than twenty blossoms before expanding were covered with paper bags —thus preventing all possibility of the access of pollen. Out of this number but two developed fruits. These were typical in form and of average size—being about sixteen inches long and two and one-half inches in diameter. They contained a large number of partially developed ovules—some of them 3-8 inch long—extending nearly the whole length of the fruit. There were no perfect seeds, however, as shown by Figure 5.

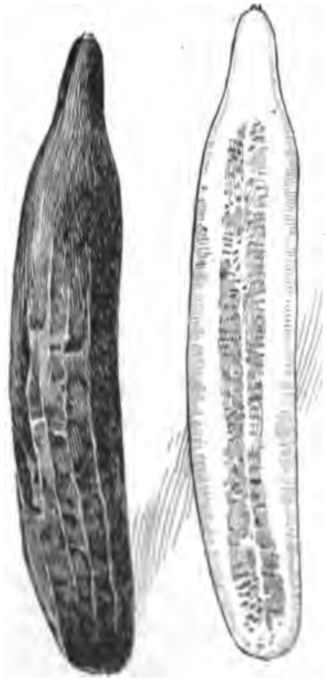

Fig. 5. *Telegraph, Seedless.*

Of ten blossoms of the variety known as "Sion House," covered as above, one developed fruit. Later many other blossoms were covered and some fruits were developed, but the percentage was about the same as before. The fruits, as with the "Telegraph," were straight and smooth and contained an abundance of partially developed ovules along the whole length of the fruit; but there were no perfect seeds. Other fruits of both varieties, left to natural conditions, were examined and as a rule were found to contain no perfect seeds. Indeed, this absence of seeds is a matter of common observation, and is urged as a point of excellence in favor of the English varieties. In one instance two or three apparently good seeds were found, but no embryo was present, while most of the ovules were only one-eighth to one-fourth inch in length. There are few if any insects in a forcing house in midwinter which would be likely to carry pollen; and it is probable that fruits left to natural conditions received no pollen.

Other varieties exhibit characteristics peculiar to themselves, when pollen is withheld. "Blue Gown," for example, is almost invariably withered and shrunken at the apex or "blossom end," as shown in Figure 6. The same tendency is shown by the "Duke of Edinburg." No seeds are developed in these fruits, and at maturity they are often hollow at the lower end as shown in Figure 7.

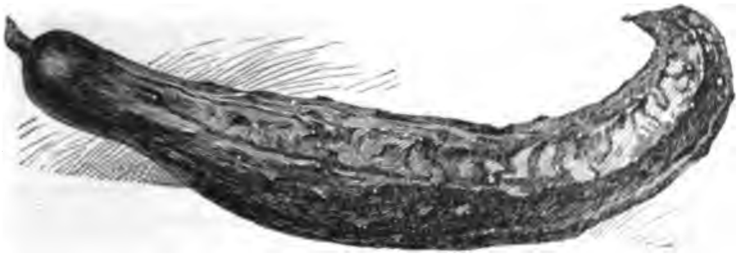

Fig. 6. *Blue Gown, not Pollinated.*

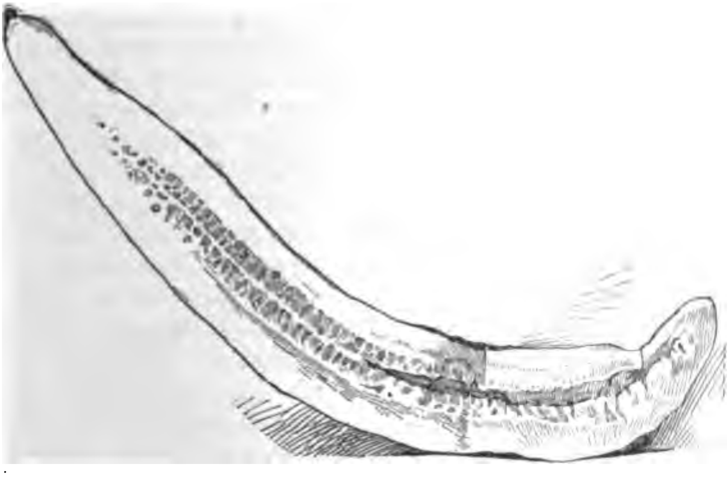

Fig. 7. *Duke of Edinburg, not Pollinated.*

In several instances I have observed the development of fruits on the "Duke of Edinburg," when the blossom never expanded. One of these is shown in Figure 8. The mature fruits were in every respect like those from which pollen was excluded by artificial means.

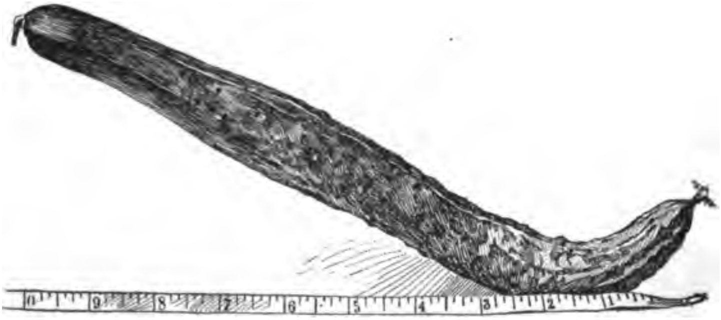

Fig. 8. *Duke of Edinburg.*

In our studies of the egg plant — *Solanum melongena* — we have at different times secured well developed fruits from blossoms which had been castrated and covered with paper bags to prevent access of foreign pollen. In no case have perfect seeds been found. The first instance noted was in the summer of 1890, and the fact was published the following spring.[*] During the past winter, 1891-92, experiments in this line have been repeated on plants growing in the house. Out of fifteen blossoms emasculated and covered, two apparently good fruits developed. One of these when about six weeks old began to decay, and was picked, and photographed. This fruit is shown in Figure 9.

As will be observed, the outer portions of the fruit grew much more rapidly than the inner,—the placentæ evidently requiring the stimulus of the growing ovules to induce development. The abortive ovules appear in the cavity as minute brown particles. A very few of them — ten in the whole fruit — were partially developed; indicating the possibility of a few grains of pollen having reached the stigma. The work was very carefully performed, however, and I am confident there is no error. The other fruit referred to is shown in the frontispiece. This fruit remained on the plant until fully mature. As will be seen, the fruit is normal in every respect except that it is *absolutely* seedless.

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[*] Bailey and Munson, Experiences with Egg Plants. Bul. 26, Cornell Exp. 19.

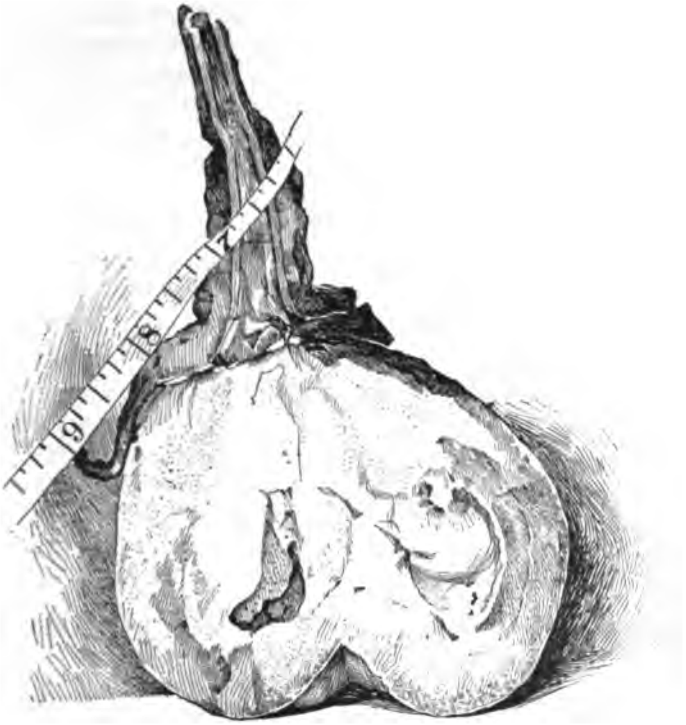

Fig. 9. *Egg Fruit, not Pollinated.*

It is interesting in this connection to note the fact that these fruits have usually, though not invariably, developed on cross-bred plants, rather than on fixed varieties,—a fact apparently in accord with the supposition before expressed, that excessive vigor of the plant is a prime requisite for the appearance of the phenomenon, for I have observed that as a rule, the cross-bred plants are apparently stronger and more productive than the others.

A further indication that excessive vigor of growth may affect the fruit, is in the abnormal development of the calyx of the egg plant in many instances, while the growth of the ovary is arrested. Usually the most prominent indication that impregnation has taken place, in the egg plant, is the rapid growth of the calyx. Many times, however, the calyx becomes much enlarged while for some reason the ovary fails to develop. I have frequently seen examples of this, in which the calyx was fully six inches long.

Another instance of the partial developnent of the ovary was observed in a Summer Crookneck squash to which pollen of another variety was applied by Professor Bailey, at the Cornell University. The fruit attained about eight inches in length, and remained in this condition during the season. No perfect seeds were developed.

From the evidence adduced the fact seems well established that in certain species, the ovary may develop and reach normal size without the corresponding impregnation of the ovules, and even in the entire absence of the male element. What the conditions are which induce this apparently abnormal condition, is not fully determined. It is evident, however, that vigorous growth of the parent plant is of first importance.

III. On the Amount of Pollen Required for Fertilization; and the Effects of Pollination on the Form and Size of the Fruit.

Kœlreuter, in 1761-66, found that with *Hibiscus venetianus* fifty to sixty pollen grains were sufficient to produce more than thirty fertile seeds in the ovary. In *Mirabilis jalapa*, and *M. longiflora*, which have a one ovuled ovary, two or three, and in some cases even one grain was sufficient for fertilization.† Now, according to Kœlruter, the Hibiscus produced 4863 pollen grains in a single flower,—or eighty-one times more than needed for actual fertilization. So also the Mirablis produced about 300 grains, or from 100 to 200 times too much. It appears therefore that there is no relation between the amount of pollen produced by a plant, and the amount required for fecundation.

Since the time of Kœlreuter, little has been done toward determining the actual number of grains required for the fertilization of any given species; but the fact has been plainly demonstrated that the amount of pollen applied may have great practical importance in determining the form and size of the fruit, as well as the quantity of fruit produced.

In crossing strawberries at the New York Agricultural Experiment Station, the fact was plainly brought out,‡ that the proportion of berries secured depends upon the abundance of the pollen furnished by the variety used as a fertilizer,— a point which is of great moment if the same law holds under natural conditions. That there may be some doubt of this, however, is indicated by the fact that certain so-called pistillate varieties — notably the Crescent — at times mature " fruit" and apparently perfect seeds in the absence of any perfect flowering variety. One grower of my acquaintance uses no perfect flowering variety, and succeeds admirably. I have never seen these plants, but it is well known that the pistillate varieties frequently produce plants having partially developed stamens, and it is probable that by unconscious selection, plants of this character have been increased to a considerable extent. In any case, the amount of pollen is necessarily quite limited.

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†Cited by Sachs, Hist. of Bot. 408.
‡5th An. Rep. N. Y. Exp. Sta. 179.

That the amount of pollen used may have an important bearing in determining the form and size of the fruit is certain. This fact, which is of special importance to the horticulturist, is shown by our work with tomatoes. In the winter of 1890-91, while crossing tomatoes, two stigmas in the same cluster of flowers were given different amounts of pollen. The first was given a very small amount — 10 to 20 grains — on one side of the stigma; the other

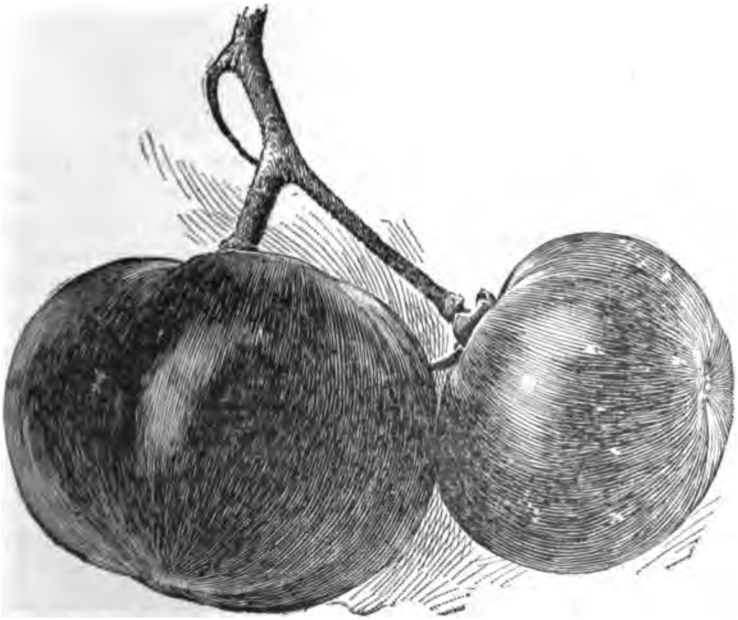

Fig. 10. *Different Amounts of Pollen.*

was given an excess of pollen, the stigma being well smeared. The effect on the form and size of the fruit was very marked. The fruit receiving the large amount of pollen was of normal size and nearly symmetrical in form, while the other was small and deformed. The larger fruit produced an abundance of seeds and all of the cells were well developed; the smaller developed seeds on one side only, while the other side was nearly solid.

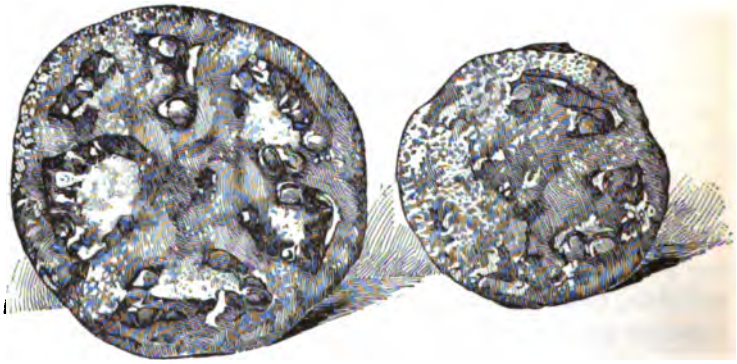

Fig. 11. *Different Amounts of Pollen.*

During the past winter the experiments have been repeated many times and the results have been uniformly similar to those detailed. In the first case, — see Figures 10 and 11 — the flower nearest the base of the cluster received an excess of pollen, while the other received a very small quantity on one side of the stigma. In another instance — Figures 12 and 13 — the flower at the base received the small amount of pollen, while the other was given an excess. Similar results were obtained, indicating that the relative position of the flower has no influence in determining this point. As will be seen from Figure 13, the seeds in this instance — but ten in number — were all born in one cell, and the deformity of the fruit was correspondingly greater than in other cases. The difference in size of the fruits was even greater in some instances than in those already cited.

The exact number of pollen-grains necessary to insure partial development of the ovary, in case of tomato, I am unable to state at the present time. Certain it is, however, that the secondary action of the pollen in stimulating the growth of the fruit is of no small importance. No doubt the greater development of the one side is largely due to fertilization of the ovules and the consequent growth of the placentæ; but that there is a further cause is indicated by the growth of the other side. Whether these results point to the possibility of securing seedless tomatoes by reducing the amount of pollen employed, is questionable. In no case have we secured fruit when all pollen was excluded, and in every case the size of the fruit was in direct proportion to the amount of pollen used.

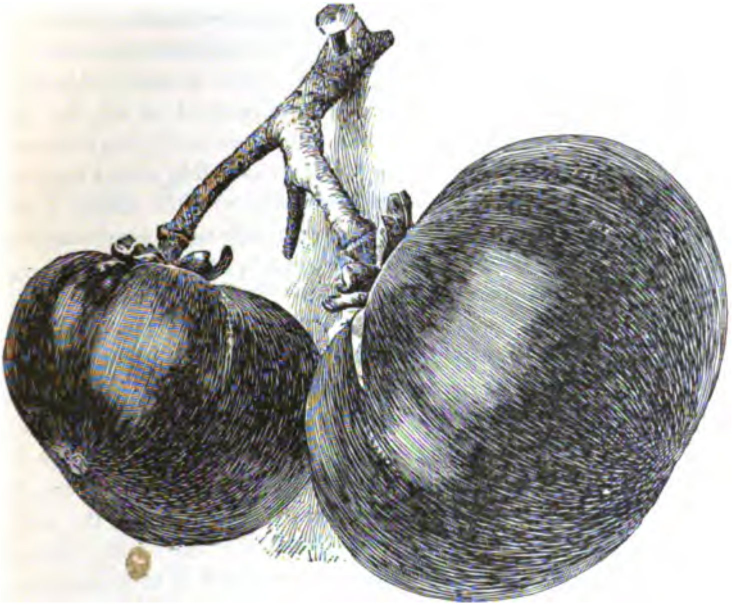

Fig. 12. *Different Amounts of Pollen.*

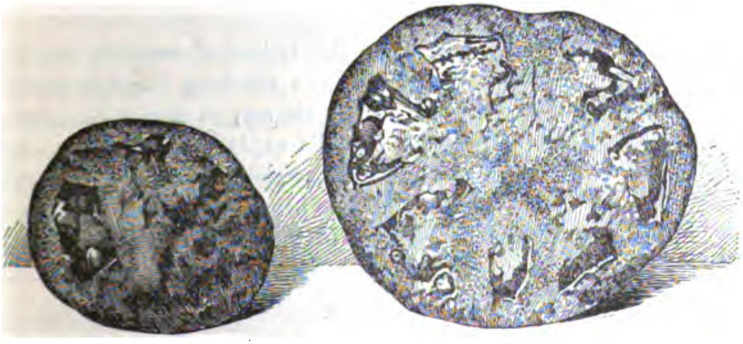

Fig. 13. *Different Amounts of Pollen.*

By careful selection we have secured tomatoes with relatively very few seeds; and Professor Bailey reports absolutely seedless fruits.[*] It is very doubtful, however, if these fruits can be regarded as any thing but variations. The habit of the plant has become so modified that the influence of the pollen in stimulating growth is stronger than its fecundating power. In none of the plants bearing relatively seedless fruits, was there an apparent lack of pollen.

A further instance of the modification of the form of fruit as a result of pollination, was observed with English cucumbers. As a rule, in cases of artificial pollination, if the fruit developed at all, the apex was much enlarged and perfect seeds were developed, — these seeds usually extending about one third of the length of the fruit. This result I have found to be almost invariable with some varieties, — notably the "Telegraph", of which an example is shown in Figure 14. This peculiarity of form is the usual result of pollination in other varieties also, but it is not invariably the case, and Professor Bailey regards the irregular form as "an expression of plant variation, rather than a result of particular treatment."[†] Certain individuals may be more susceptible to the influence of pollen than others, but as the variation is traceable directly to the action of pollen in the impregnation of the ovules, the subject may properly be considered in this connection. At the present time, however, we can only say that as a rule this particular variation is induced by the action of pollen. The reason is yet to be determined.

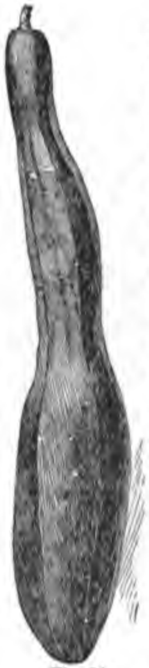

Fig. 14.
Telegraph,
Artificially Pollinated.

In other words, the reason for the failure of seeds to develop throughout the length of the ovary in the long English cucumbers, when pollen is applied to the stigma, is as yet uncertain. It appears probable, however, that the explanation lies in the extreme length of the ovary and the consequent inability of the pollen tubes to penetrate so far. There has been a variation in the ovary without a corresponding variation in the pollen. The amount of pollen applied, appears to have little effect in regard to this point.

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[*] Rep. Cornell Univ. Exp. Sta. 1891, 55.
[†] Bailey, Bul. 31 Cornell Univ. Exp. Sta. 137.

In general, while little accurate work has been done in the way of determining the exact amount of pollen necessary for fertilization, it appears that the question has bearings of much practical importance. In some instances the size of the fruit seems to be in direct proportion to the amount of pollen used, while the form is much improved by an abundant supply. In some cases, on the other hand, fruits will develop without the intervention of the male element, and the best results are obtained when pollen is withheld.

IV. On the General Influence of Foreign Pollen, and Other Miscellaneous Observations.

As already intimated, pollen appears in many cases to act directly on the ovary, stimulating growth of that organ independently of any effect on the ovules. This fact is most clearly seen in those species which do not readily cross.

In this connection, Focke remarks: "The pollen of the species acts quicker than foreign pollen and is alone effective if mixed with foreign pollen upon the stigma. * * * It is probable that if the pollen of the species is insufficient, foreign pollen may serve to develop the fruit, and thus serve a purpose."* Some instances strongly supporting this proposition have come under my observation.

One of the large English cucumbers, "Duke of Edinburg," was given pollen of the "Emerald Gem" muskmelon. The cross was made in February. The resulting fruit attained about one-half the normal size and then ceased growing. When the vines were torn from the house in June, this fruit was still green while other fruits, receiving pollen of the species two months later, were fully mature. The ovules in the fruit in question were wholly undeveloped.

Two other instances of a similar nature were observed. The first of these was the common Summer Crookneck squash crossed by the American Turban—Figure 15; while the second was the same variety crossed by Mammoth Tours pumpkin—Figure 16.†

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*Die Pflanzen michlinge, 448.

†The two crosses last named were made by Professor L. H. Bailey at Cornell University. All other illustrations are from work performed by the writer.

In both of these cases the fruit developed, as indicated, about six inches in length, and remained in that condition several weeks. No seeds were developed, and late in the summer the fruits began to decay.

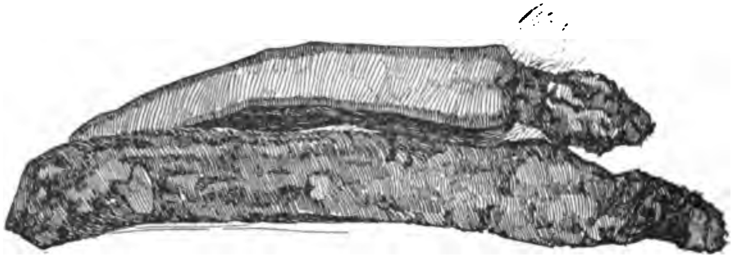

Fig. 15. *Summer Crookneck × American Turban.*

A most remarkable instance of secondary influence of foreign pollen is that recorded by Lowe.* Flowers of the yellow musk plant, *Mimulus luteus*, were crossed with *Mimulus cashmerianus* which has spotted flowers. When the pods from these flowers were nearly matured, other flowers upon the same branches were given pollen of *M. luteus.* More than one hundred seedlings were grown from these latter crosses and every one bore spotted flowers. In other words, the influence of the pollen of the foreign species was transferred along the branch and overcame the influence of pollen from the same species. (!)

This result is in direct opposition to Focke's principle of the prepotency of pollen of the species as compared with foreign pollen, and as yet, so far as I am aware, Lowe's statements have not been verified. I have undertaken to prove the truth or error of the statements, but have not as yet reached conclusions.

Superfœtation: Is it possible that the progeny of any plant may be in any way affected by the application of foreign pollen to the stigma after self-fertilization has already taken place? Is it possible to obtain distinct effects from two male parents when the pollen is applied at different times?

Comparatively little has been done towards solving these questions, and they are suggested as promising lines of investigation rather than as subjects for extended discussion at this time. Both Gray† and Focke‡ have denied the possibility of superfœtation, but other observers have cited instances in support of the

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*E. J. Lowe, Rep. British Ass'n for Adv. of Sci. 1885, p. 1081.
†Am. Jour. Sci. and Arts XXV, 123.
‡Die Pflanzen mischlinge, 448.

theory and certain facts have come within my own observation which point to the possibility of several seeds in the same ovary being the product of different male parentage.

Grieve, in 1874,* individually pollinated several blossoms on some plants of *Pelargonium peltatum*. One of these plants was on the day following given pollen of *Pelargonium zonale*. The offspring of the first plant were all true *Pelargonium pelatum;* while of the offspring of the second, no two were alike, the leaves of some being large and of others small; some showed a well developed zone, while others were without any indications of this character.

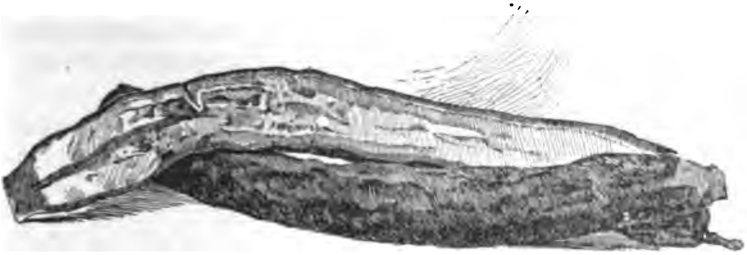

Fig. 16. *Summer Crookneck* × *Mammoth Tours Pumpkin.*

Charles Arnold, in crossing corn, used pollen from both a yellow and a white variety, on pistils of a dark purple sort. The resultant grains were yellow at the base and white at the top; while those of another ear on the same stalk, being individually pollinated, were of normal color.† This instance established in the mind of Mr. Arnold the fact of the possibility of superfœtation, and was used by Thomas Meehan‡ as the basis for an argument in support of the theory of the immediate influence of foreign pollen as well as of the theory of superfœtation. So far as I am aware, similar results have not since been obtained.

In applying small amounts of pollen to the stigmas of tomatoes, I have observed that the portion of the stigma receiving pollen soon turned brown and withered while the other side remained green and in an apparently receptive condition for some time. This fact was specially apparent in the fruit shown in Figure 12. As seeds develop only on the side receiving pollen, it seems probable that seeds on the other side of the ovary might well be fertilized by pollen of a different variety or species. This point is now receiving special attention.

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*Gard. Chron. Vol. II, (N. S.), 689.
†Gard. Month. XV, 104.
‡Proc. Phil. Acad. Sci. 1873, 16.

CONCLUSION.

From a study of the laws of heredity, conclusions of vast importance in the systematic amelioration of plants have been reached. At the present time, however, but little is known of the laws controlling the numerous secondary results attending the crossing of plants. From the evidence at hand it appears that the secondary results may be of fully as much importance as are directly inherited qualities.

There is little doubt that in a few important species there may be an immediate apparent effect of foreign pollen on the female organism of the current generation. It is equally certain, however, that the greater portion of food plants which have received special study do not exhibit any immediate apparent effects of foreign pollen; while other species are still in dispute.

That pollen has a direct stimulating effect on the ovary, independently of its action on the ovules, seems a well established fact. In many cases the size of the fruit is in direct proportion to the amount of pollen used; but it is also true that in many cases the fruit may develop to a considerable degree, or even to its normal size, in the entire absence of the male element. What the conditions are which insure this phenomenon is as yet uncertain. Exceedingly vigorous growth of the plant is certainly a first requisite, but there also seems to be an individual variation in this direction, with some species.

Variations in the amount of pollen available, may to a large extent determine the form and consequent value of the fruits of some species. It is certain that in some instances — as with tomatoes — the best practical results are obtained from an excessive supply of pollen; while on the other hand, some fruits — as is true of the English cucumber — may be of better form if pollen is withheld.

Whether superfœtation is possible, is a question of no small importance, but the evidence is as yet insufficient for conclusions to be drawn.

With all cultivated plants there is a tendency to revert to ancestral forms, and it is important that this fact be borne in mind in assigning definite causes to results obtained; otherwise, erroneous conclusions will often be reached.

GENERAL SUMMARY.

1. The evidence at hand indicates that within certain limits there is an immediate influence of pollen on the mother plant; but that these limits are quite restricted.

2. The most important plants showing, unmistakably, immediate effects of foreign pollen are the pea, the kidney bean and the Indian corn. It is possible that the orange may be included in this list.

3. Sweet corn shows the effect of foreign pollen more frequently than do the other races of corn

4. Cucurbitaceous and solanaceous plants have not been fonnd to exhibit immediate effects of pollen.

5. Rosaceous plants are in dispute, but the weight of authority would indicate an absence of immediate effect.

6. The theory of the double action of pollen—stimulating as well as fertilizing—as suggested by Naudin and Focke, seems plausible; but in some species the ovary will develop in the entire absence of pollen.

7. The most important examples of agamic development of fruit, are seen in the Egg Plant—*Solanum melongena*—and the English forcing cucumber—*Cucumis sativus.*

8. In no instance, when pollen is witheld, are perfect seeds developed.

9. There appears to be no relation between the amount of pollen produced by a plant and the amount required for fecundation.

10. There appears to be no relation between the amount of pollen produced by a plant and the number of seeds produced by its fruits.

11. The amount of pollen applied may in many cases be of great practical importance in determining the form and size as well as the quantity of the fruit produced.

12. The amount of fruit produced by certain varieties of strawberries appears to vary, in some instances, with the amount of pollen supplied by the variety used as a fertilizer; but this occurrence is not universal.

13. The form and size of tomato fruits are directly dependent on the amount of pollen furnisheda,— small amount invariably resulting in small and deformed fruit.

14. The English forcing cucumber is usually deformed by the production of seeds and the consequent enlargement of the apex, as a result of pollination; the amount of pollen used appears to be of no importance in determining the extent of the deformity.

15. Pollen appears in many cases to act directly on the ovary, stimulating growth of that organ independently of any effect on the ovules,—an effect most clearly seen in those species which do not readily cross.

16. Indications point to the possibility of distinct effects from two male parents when pollen is applied to the same stigma at different times.

REPORT OF THE HORTICULTURIST.

W. M. MUNSON.

In many respects the work of the horticultural department has been a continuation of that of last year. As indicated in my last report two distinct lines of work are in view; one being a study of principles and the laws affecting plant growth; the other a practical investigation of ways and means for immediate guidance in the culture of fruits and vegetables.

In studying the variations of plants, it is interesting and important to know what results may be expected from certain of the operations performed in the process of amelioration. During the past year special attention has been given to a study of the effects of pollination. The results of this study were published as Part II of the annual report of the experiment station. The field for investigation in this direction is very promising.

The work with insecticides and fungicides has been continued during the year and valuable lessons have been learned. Owing to the excessively wet season, results were not so marked as last year, but the beneficial effects of spraying are evident, and further effort in this line is warranted.

In our work with vegetables the tendency is to specialize rather than to grow a large number of varieties—particular attention being given to cabbages, tomatoes and egg plants. In the forcing house the pepino and the English cucumber, as well as the tomato, lettuce, radishes and other common crops demand attention. It is believed that with proper management the pepino may be made a profitable crop for winter forcing in those localities which can command a fancy market. A special report concerning the forcing of vegetables is now in preparation.

The fruit plantations have been largely extended and systematized, and with the provisions for increased assistance next year it is hoped the work may be prosecuted with renewed vigor.

THE VEGETABLE GARDEN.

While a greater variety of vegetables was grown during the past year than in 1891, we shall confine our report at this time to certain notes concerning cabbages, tomatoes and egg plants. Other important vegetables will receive attention at a later date.

I.—NOTES OF CABBAGES.

As in the previous season, the study of cabbages was confined mainly to a few questions relative to methods of culture,—including the effects of handling; effects of trimming; a comparison of varieties, and the testing of the newer varieties.

No strictly new varieties were grown this year. "Nonesuch" and "Worldbeater," which were grown for the first time last year, were tried again and the good opinion expressed at that time regarding the first variety is confirmed. It is a very good second early sort. The average weight of this sort was about eight and one-half pounds. "Worldbeater" is a little later and in no way so satisfactory. The average weight of the heads is about the same as that of "Nonesuch."

Seeds from Long Island and from Fidalgo, Washington, did not give widely different results. The plants from both lots were very strong and vigorous from the start.

1. *Effects of Trimming:* It is frequently asserted that cabbage plants will thrive much better and give better results, if the leaf surface is reduced by about one-half at time of transplanting; since little growth will be made till the roots become established and the first leaves usually wither and fall away. To test this point, a number of plants of several varieties were trimmed at the time of setting in the field, while others of the same lots were not disturbed. Rain fell soon after the plants were set and all of them grew remarkably well. The results are shown in the table.

TABLE I.—EFFECTS OF TRIMMING CABBAGE PLANTS.

VARIETY.	No. of heads.	Total weight. lbs.	Heaviest head. lbs.	Lightest head. lbs.	Av'ge weight. lbs.	No. of heads cracked.	No. heads immature.	No. heads not cut.	Ratio.
EARLY SUMMER.									
Trimmed......	8	24.0	3.75	2.25	**3.00**	0	0	0	**1.00**
Not trimmed..	6	22.1	4.75	2.50	**3.70**	0	1	2	**1.23**
ALL SEASONS.									
Trimmed......	15	116.5	12.87	3.87	**7.77**	1	0	1	**1.28**
Not trimmed..	11	66.5	11.50	2.19	**6.05**	0	3	0	**1.00**
WORLD BEATER.									
Trimmed......	15	124.5	11.75	4.56	**8.30**	1	0	0	**1.00**
Not trimmed..	17	143.0	13.87	5.37	**8.40**	0	0	0	**1.00**

As will be observed, there is little difference in the average weight of the heads from trimmed and untrimmed plants. With one variety the ratio is decidedly in favor of the trimming, while with another the indications are generally as positive in the opposite direction; while the third is neutral.

Conclusion: From work performed, it is impossible to make definite statements as to the value of trimming cabbage plants at time of setting.

2. *Influence of Transplanting:* Limited space in the forcing house prevented the continuation of this experiment on a scale as extensive as had been planned. A number of plants of two varieties, however, were given the same treatment as last year, *i. e.*: The plants handled in pots were removed from the seed-flats to three-inch pots, and later to four-inch pots. Those handled in boxes were placed two inches apart at the first transplanting and about four inches each way at the second. The boxes used were ordinary seed-flats, 16x20 inches, and about three inches deep. When placed in the field, all were set in rows three and one-half feet apart and two feet apart in the rows.

The results are shown in table II.

TABLE II.—POTS VS. BOXES.

VARIETY AND TREATMENT.	No. of heads.	Heaviest head, lbs.	Lightest head, lbs.	Av'ge weight, lbs.	No. of heads cracked.	No of heads immature.	No. of plants not cut.	Ratio.	Remarks.
JERSEY WAKEFIELD. (Brill.)									
Pots	22	5.50	2.00	**3.50**	7	1	0	**1.42**	Cut Aug. 4.
Boxes	56	5.94	.87	**2.47**	5	12	2	**1.00**	
STEIN'S FLAT DUTCH. (Thorburn.)									
Pots	17	12.87	4.31	**8.62**	5	0	0	**1.12**	Cut Aug. 24.
Boxes	24	13.00	2.94	**7.67**	4	0	0	**1.00**	

In each instance the average weight of the product is decidedly in favor of the plants handled in pots. This result confirms that obtained last season with the first variety, but contradicts that obtained with the second. The plants handled in pots were manifestly earlier and better than those from boxes, and the question now arises, whether the difference is sufficient to warrant the additional expense.

It is of interest to note that *Jersey Wakefield* seems specially susceptible to good treatment. In 1891 the ratio of the pot-grown plants to those grown in boxes was as 1.38 : 1.00, while the present season, as will be seen from the table, the ratio is as 1.42 : 1.00. Plants of this variety which were set deeply have almost invariably given better results than those set shallow, while other varieties have given various results in different years, though the same treatment was given.

Conclusion: The results are contradictory to those obtained in 1891, and indicate that pot-grown cabbage plants are earlier and better than those grown in boxes.

II.—Notes of Tomatoes.

The number of varieties grown the past season was not so large as in 1891, attention being given more particularly to methods of culture.

1. *Effects of Early Setting:* From our study of this subject last season, we found that: "On a warm, sandy soil, the earliness and productiveness of tomatoes were in direct ratio to the earliness of setting in the field," and that "a chill is not as fatal to success as is commonly supposed."* Accordingly, our principal setting was made on June 1st this year—nearly two weeks earlier than usual in this climate.

To verify the conclusions reached last year, when only one variety was used, three dozen plants of each of four varieties were set apart and given the same treatment in every way while in the house, all being transferred from the seed flats to 2-inch pots, then to 3-inch, and finally to 4-inch pots. The season being somewhat backward, the first lot was not put out until May 19. The other two lots were put out June 1st and June 15, respectively.

The night following the first setting there was a slight frost and the weather was cold and raw for a week following. As the plants were taken directly from the hot house, without "hardening off," the test was a severe one.

Table III shows very clearly the results obtained from this trial.

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* Rep. Maine Exp. Sta. 1891, p. 91.

TABLE III.—EARLY AND LATE SETTING.

VARIETIES.	Date of setting.	No. of plants.	Av. No. fruits per plant.	Av. wt. of fruits per plant. lbs.	Av. wt. of individual fruits. oz.	Date of first ripe fruit.
EARLY RUBY.						
1st setting	May 19.	8	22.6	5.87	4.2	July 29.
2d "	June 1.	11	13.3	4.47	4.2	" 26.
3d "	" 15.	11	7.7	1.69	3.5	" 22.
ATLANTIC.						
1st setting	May 19.	12	10.2	2.14	3.4	Aug. 1.
2d "	June 1.	10	9.3	1.89	3.2	July 29.
3d "	" 15.	12	5.3	0.98	2.9	" 22.
NEW JERSEY.						
1st setting	May 19.	12	12.8	5.19	6.5	Aug. 9.
2d "	June 1.	12	12.0	5.00	6.7	" 8.
3d "	" 15.	12	4.4	1.33	4.8	" 6.
BEAUTY.						
1st setting	May 19.	12	18.4	7.10	6.2	Aug. 9.
2d "	June 1.	10	16.6	6.60	6.4	" 1.
3d "	" 15.	12	1.4	0.17	1.9	" 3.

From the table we learn first of all, that the first ripe fruits, in every instance save one, were obtained from the plants set latest. This fact, however, is not necessarily an indication of earliness, as the late-set plants were older than is usually desirable for setting and the first fruits were in some cases from blossoms formed while in the house. After these had ripened there was a long interval before others followed.

Without exception, the average number of fruits and the average weight of the product per plant, was in direct ratio with the earliness of setting,—a direct confirmation of results obtained last year. The average weight of individual fruits was not essentially different in the first two settings, but was decidedly less in the last lot.

2. *Effects of Bagging Fruit*: The editor of one of the leading agricultural papers* last year suggested covering the fruit with paper bags, as a means of inducing early ripening, claiming that in this way maturity might be hastened by several days. It is impracticable to cover individual fruits, but whole clusters on different plants of several varieties were covered and duplicate clusters of the same age were marked for comparison.

The following notes indicate the results:

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* Rural New Yorker.

		Size at time of covering.	Date of ripening.
IGNOTUM.			
1	Covered July 14	Size of pea.	Aug. 29.
	Not covered	" "	" 19.
2	Covered Aug. 6	" "	Sept. 21.
	Not covered	" "	" 21.
PERFECTION.			
1	Covered July 12	" "	Aug. 19.
	Not covered	" "	" 19
2	Covered July 14	" "	" 29.
	Not covered	" "	" 19.
3	Covered July 14	½ inch.	" 29.
	Not covered	"	" 18.
4	Covered Aug. 6	"	Sept. 27.
	Not covered	"	" 21.
5	Covered Aug. 6	Size of pea.	" 27.
	Not covered	" "	" 27.
PRELUDE.			
1	Covered July 14	½ inch.	Aug. 19.
	Not covered	"	" 17.
2	Covered July 14	"	" 18.
	Not covered	"	" 15.
3	Covered Aug. 13	¾ inch.	Sept. 27.
	Not covered	"	" 27.

In no instance did the fruit ripen earlier when covered, and in more than half of the cases considered, that not covered matured first.

Conclusion: Little or no benefit seems to be derived from the practice of bagging tomato fruits.

3. *Individual Variation:* In the culture of tomatoes, as of other garden crops, conclusions as to best methods are too often drawn from the results of a single season's work. There is little doubt that many of the conclusions thus reached are often misleading, for it is believed that the individual variation of the plants of any given variety is often such as to obscure any effects of different methods of treatment.

As bearing upon this question, duplicate lots of one dozen of each of several varieties were selected at the time of the first transplanting, and were given the same treatment at all times, being handled alike in the house and set in parallel rows in the field.

The comparative results are seen in table IV.

TABLE IV.—INDIVIDUAL VARIATION.

VARIETY.	Av. No. ripe fruits per plant.	Av. wt. of fruits per plant. lbs.	Av. wt. of individual fruits. oz.	Date of first ripe fruit.
Golden Queen	11 20	3.96 6.00	5.6 4.9	Aug. 8. " 4.
Ignotum	13 12	5.87 5.23	7.0 7.2	Aug. 1. " 1.
Perfection	24 17	8.90 5.70	5.8 5.5	Aug. 4. " 1.
Prelude	27 41	3.36 4.82	2.0 1.9	July 25. " 29.

In no case were the results obtained from the duplicate lots uniform. The variation in weight of individual fruits, and in the time of ripening, varied but slightly; but the number and weight of the product was very marked.

Conclusion: Positive conclusions should never be drawn from the results of a single season's work.

4. *Color:* As noted in last year's report, many attempts have been made to improve upon the color of the fruit of the tomato. The cross between Golden Queen and Ignotum, grown in the college gardens last year, gave no indication of any influence of the yellow parent; but the second generation was decidedly variable, about half of the plants bearing red fruits and the others yellow, with no indication of the desired blush form.

A selected strain of Golden Queen having a tendency to produce fruit with a blush cheek, is as yet only imperfectly fixed; but as grown in the house, this tendency is very nicely brought out and the fruits are very attractive.

A new variety to be introduced in 1893 by J. M. Thorburn & Co., of New York, as "Lemon Blush," is said to be a firmly fixed variety of the type sought. This variety originated with Mr. E. S. Carman, editor of the Rural New Yorker.

5. *Crossing:* Tomato growing in the high latitudes is often unsatisfactory for the reason that but a very small proportion of the fruit will mature before the plants are killed by frost. It is therefore important that some variety be secured which shall perhaps combine the size and quality of the better market sorts now extant with the earliness and prolificness of some of the smaller

sorts valuable only for preserves or catsup. With this end in view numerous crosses have been made, and the results obtained are interesting and promising.

During the winter of 1891-2 crosses were made between Ignotum, one of the most valuable market varieties, and the Peach, a very productive variety of excellent quality but small and soft.* Several plants resulting from this cross were grown in the field during the past summer, and were highly satisfactory. The fruit was in general not very different from the Ignotum, though averaging smaller; but the increase in productiveness was very marked. Whereas the average number of ripe fruits per plant on the pure Ignotum plants was but **18**, that on the crossed plants was **40**. The average weight of individual fruits, however, was but 3.3 oz. as compared with 7.5 oz. in case of the Ignotum.

In another instance two flowers on one cluster of the Lorillard were artificially pollinated—the one with Peach, the other with Lorillard pollen. The products of these crosses were given the same treatment throughout the season and were planted side by side in the field. The plants were essentially Lorillard in appearance, and the fruits as a rule were of this type, but some of the fruits showed distinctly the effects of the staminate parent.

The following figures represent very well the comparative yield of the two lots:

	Av. No. ripe fruits per plant.	Av. wt. of fruit per plant, lbs.	Av. wt. of individual fruits. oz.	First ripe fruit.
Lorillard × Peach..............................	40	8.1	3.2	Aug. 12.
Lorillard × Lorillard........................	13	4.1	5.0	" 23.

The figures are significant. As will be observed, the individual fruits of the cross with Peach are somewhat smaller than those of the pure Lorillard—being about intermediate between the usual sizes of the two parents—but the number of fruits is trebled, while the average weight per plant is doubled. The date of ripening also is hastened by more than a week. The fruit showed little tendency toward the peculiar roughness of the male parent. All things considered this cross is very promising.

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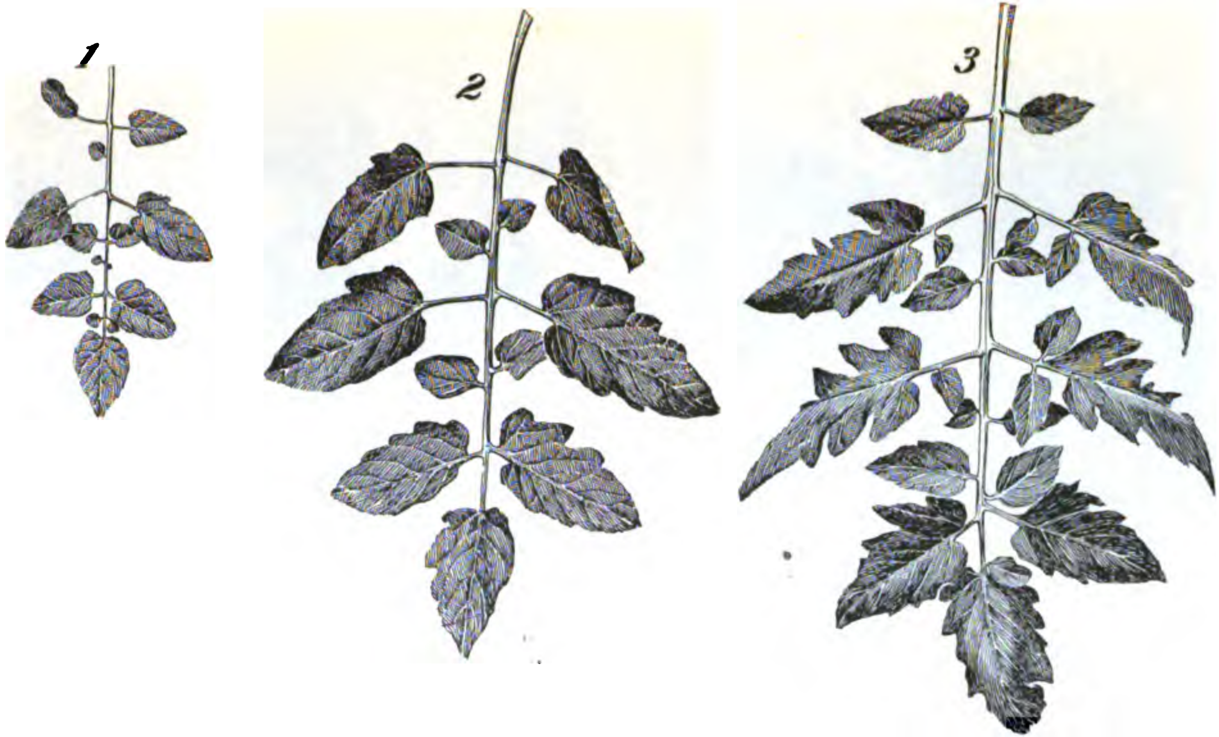
* For description of these varieties see Rep. Maine Exp. Sta. 1891, pp. 91 and 92.



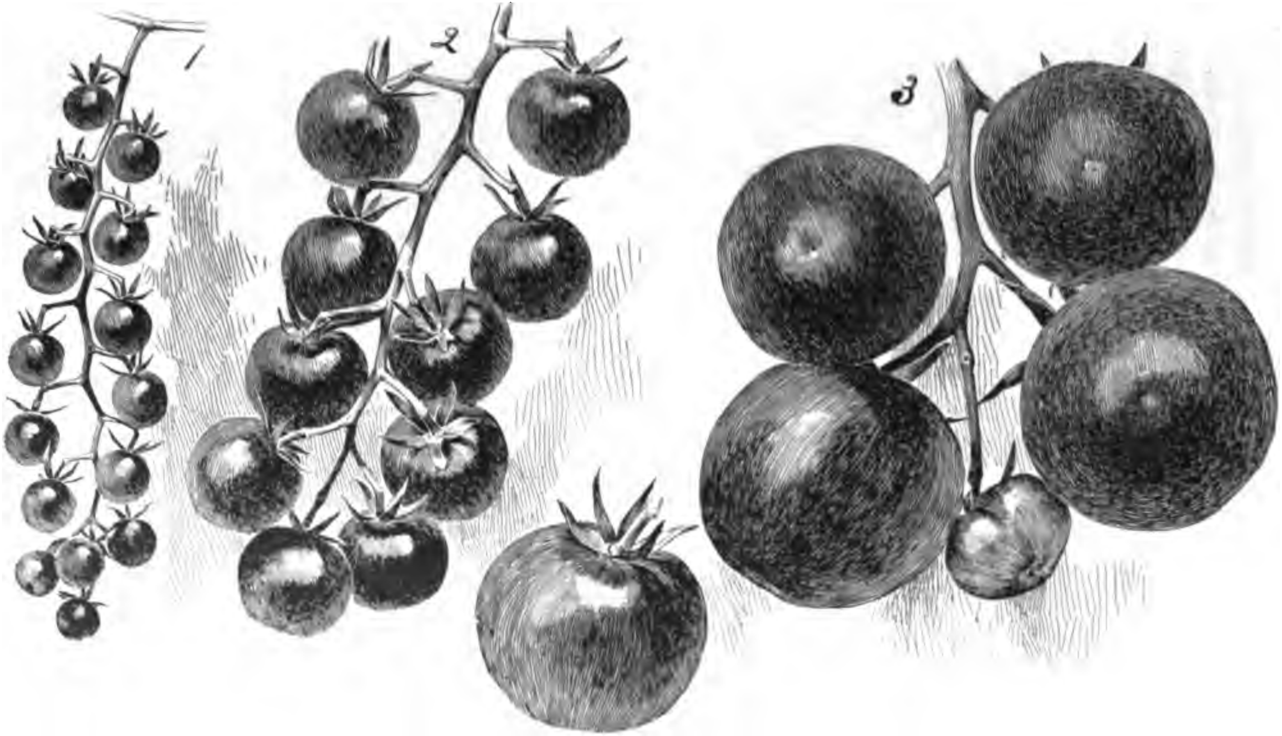
1. Currant. 2. Hybrid. 3. Lorillard.

Fig. 1 Lorillard × Currant.

Besides the crosses already named, a true hybrid was secured between the Lorillard and the Currant. The Lorillard is a well-known variety of medium size and of only moderate productiveness, belonging to the common type of *Lycopersicum esculentum*, while the Currant belongs to a distinct species—*Lycopersicum pimpinellifolium*. The Currant tomato is of weak spreading habit, with small, thin foliage and very delicate flowers, arranged in two ranks on a long raceme. These flowers, from 10 to 20 in number, are highly self-fertile and the fruit very closely resembles long clusters of cherry currants. The difference in the appearance of the leaves of the two varieties is very well shown in Fig. 1, Nos. 1 and 3. The difference in the flowers is equally marked, those of the Lorillard being somewhat conical, with the calyx lobes much longer than the petals; while those of the Currant are slender and the calyx lobes are so small the petals and stigma often protrude.

The resulting hybrids were intermediate between the parents in nearly every particular. The character of the foliage is well shown in Fig. 1, No. 2. The fruit, which from a practical point of view is most important, presented a very attractive appearance. Much of the productiveness of the Currant is shown, while the influence of the size of the Lorillard is also exhibited. The size and character of the fruit may be seen from Fig. 2. No. 1 represents the male parent — Currant; No. 3, the female — Lorillard; while No. 2 is the hybrid, all being about one-half size. The detached fruit shows the natural size of the hybrid.

Our purpose now is, by futher combining the hybrid with the Lorillard, to increase the size of the fruit, at the same time retaining if possible the prolific tendencies of the plant. To this end crosses have been made of the hybrid on the Lorillard and of the Lorillard on the hybrid and the results are awaited with interest.



1. Currant. 2. Hybrid. 3. Lorillard.

Fig. 2. Lorillard × Currant.

6. *Secondary Effects of Pollen:* This matter was discussed in Part II of the annual report of this experiment station for the present year; but as that report was of a technical nature and not printed for general distribution, some of the notes there given referring to the tomato may be repeated in this connection. From our studies of the subject of plant breeding, we have found that the amount of pollen falling on the stigma of the tomato flower may have an important bearing in determining the form and size of the resulting fruit. In the winter of 1890-1, while crossing tomatoes, two stigmas in the same cluster of flowers were given different amounts of pollen. The first was given a very small amount, while the other was given an excess. The resulting fruit from the first flower was small and deformed, while the other was of normal size and nearly symmetrical in form. The larger fruit produced an abundance of seeds and all of the cells were well developed; the smaller developed seeds on one side only, while the other side was nearly solid. This difference is very well shown in figures 3 and 4.

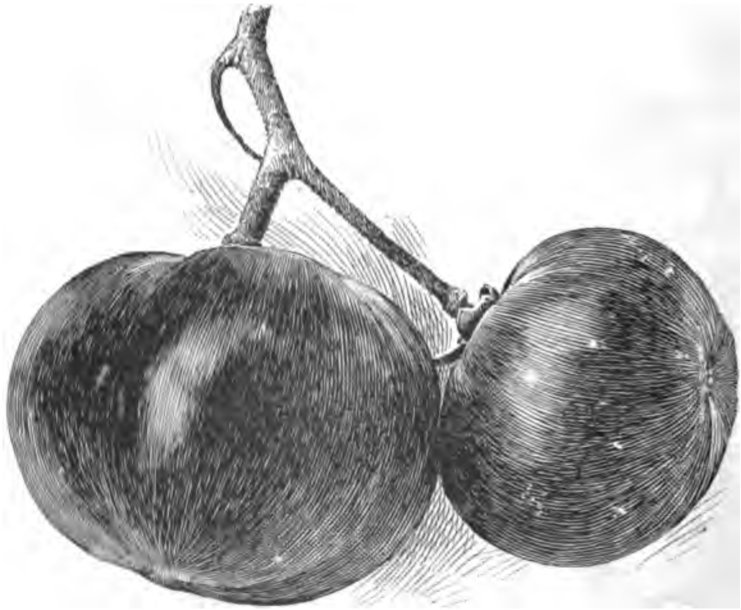


Fig. 3. *Different Amounts of Pollen.*

It is certain that the secondary action of pollen in stimulating the growth of the fruit is very important, and the question naturally arises as to what influence would be manifested on the offspring. Seeds from several of the fruits under study were sown in the house, but owing to an accident the test as to per cent. and rapidity of germination was abandoned. Several plants of each lot were grown, however, and were treated precisely alike during the season, with the results shown in the accompanying table.

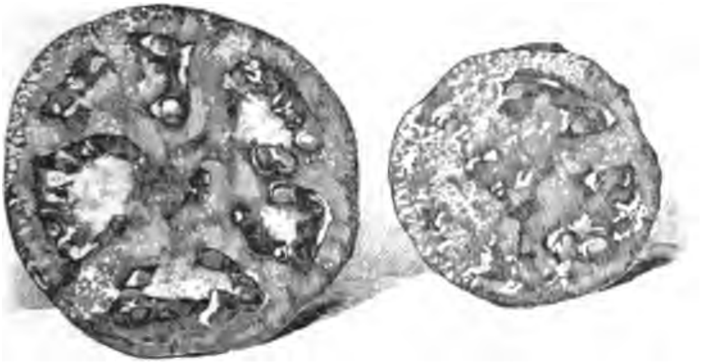


Fig. 4. Different Amounts of Pollen.

Each cluster of fruits is designated by a letter and the individual fruits by the word "maximum" or "minimum" according as an excess or a very small amount of pollen was employed.

TABLE V.—SECONDARY INFLUENCE OF POLLEN.

		No. of plants.	Av. No. of fruits per plant.	Av. wt. of fruit per plant, lbs.	Av. wt. of individual fruits, oz.	Date of first ripe fruit.	No. fruits ripe before Sept. 15.
A	Max	3	69	17.7	4.11	Aug. 9	23
	Min	3	68	17.3	4.09	" 8	25
B	Max	4	50	10.7	3.43	Sept. 1	21
	Min	2	27	4.6	2.74	" 5	8
C	Max	6	58	13.3	3.70	Aug. 6	38
	Min	3	70	15.3	3.49	" 12	15
E	Max	6	82	21.1	4.62	Aug. 17	20
	Min	4	74	20.0	4.32	" 18	22

As a rule, the offspring from the fruits receiving an excess of pollen were slightly the more productive and without exception the average weight of the individual fruits from these plants was greater. In general, however, the difference was but slight.

Further study on this point may throw some light on the question of the importance of the individual characteristics of a fruit in the selection of seed. We have already observed* that the character of the individual fruit is of less importance than that of the parent plant as a whole, but it also seems that the small size of the fruit, which we now believe specifically due to imperfect pollination, may be co-incident with lack of vigor, and that this lack of vigor will be apparent in the offspring to a greater or less extent.

8. *Varieties:* Among the varieties grown the past season were most of the older standard sorts and some of the more recent introductions. The accompanying table will give a comprehensive view of the comparative merits of these varieties as regards size, productiveness and earliness.

TABLE VII.—COMPARISON OF VARIETIES.

VARIETIES.	No. of plants.	No. of fruits.	Av. No. fruits per plant.	Wt. of fruit per plant. lbs.	Av. wt. of individual fruits. oz.	Date of first ripe fruit.	No. of fruits ripened before Sept. 15.
Americus Hybrid	11	131	11.9	4.74	6.4	Aug. 1.	40
Atlantic	12	194	16.2	4.20	4.2	July 29.	70
Chemin Market	12	169	14.1	3.96	4.5	Aug. 1.	59
Cleveland	11	158	14.4	6.00	6.7	" 11.	39
Early Richmond	12	201	16.7	5.65	5.0	" 8.	89
Early Ruby	12	200	16.7	5.13	4.9	July 26.	81
Essex Hybrid	11	117	10.6	3.92	5.9	Aug. 2.	35
Faultless	12	310	25.8	7.21	4.5	" 1.	93
Favorite	12	135	11.2	4.46	6.4	" 8.	39
Golden Queen	11	124	11.3	3.96	5.6	" 8.	38
Ignotum	12	161	13.4	5.87	7.0	" 1.	61
Ithaca	10	202	20.2	5.34	4.2	July 29.	82
Long Keeper	12	241	20.1	6.93	5.5	Aug. 11.	34
Lorillard	12	249	20.7	7.57	5.8	" 3.	69
Livingston's Beauty	12	164	13.7	4.95	5.8	" 9.	45
Mikado	11	170	15.5	8.00	8.3	July 25.	42
Mitchell	11	203	18.5	6.11	5.8	Aug. 8.	50
New Jersey	12	168	14.0	6.48	7.4	" 12.	31
Optimus	12	299	24.9	7.89	5.1	" 1.	98
Paragon	12	141	11.7	4.74	6.5	" 9.	38
Perfection	10	140	14.0	5.00	5.7	" 2.	41
Ponderosa	11	67	6.1	4.19	11.0	" 11.	14
Potomac	12	207	17.2	2.55	7.0	" 4.	47
Potato Leaf	11	222	20.2	7.40	5.9	" 2.	48
Prelude	12	327	27.2	3.36	2.0	July 25.	129
Red Cross	12	209	17.4	6.00	5.5	Aug. 2.	46
Stone	11	111	10.1	3.90	6.2	" 8.	25
Table Queen	12	173	14.4	6.40	7.1	" 2.	51
The Hovey	9	153	17.0	6.20	5.8	" 5.	45
Volunteer	12	226	18.8	6.73	5.7	" 5.	78
Yellow Victor	12	328	27.3	7.27	4.3	" 1.	136

The most productive varieties, in point of number, were Yellow Victor and Prelude, with an average of 27 ripe fruits per plant, before frost. Following these were Faultless with 26, and

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* Bulletin 21, Cornell University Experiment Station, page 75.

Optimus with 25; while Lorillard, Potato Leaf, Ithaca and Long Keeper ripened about 20 fruits each. Some of the larger fruited sorts produced a greater weight of fruit, but there were not as many individuals, and as a rule, medium-sized varieties are more to be desired. Prelude is very small and Optimus, with its average of 25 fruits, is far superior to it.

The date of the first ripe fruit is not an exact criterion of earliness of the crop, but in average seasons frost may be expected any time after Sept. 15, and the number of fruits ripe at that date is a safe guide, other things being equal, in selecting an early variety. The five varieties ripening the greatest number of fruits at this time were respectively, Yellow Victor, Prelude, Optimus, Faultless and Early Richmond. As will be seen, Optimus again stands third in the list and it is by far the best of the five varieties named. Of the other most productive and valuable sorts, Ithaca matured the most fruit before the date above mentioned, while Early Ruby and Volunteer came next in order.

The following field notes concerning the most important varieties were made:

Atlantic. (*Atlantic Prize*, Thorburn).—Of medium size, red, irregular, better than in 1891, but not of sufficient merit to retain.

Beauty. (*Livingston's Beauty*, Livingston).—Still a favorite pink tomato. Smooth and handsome, but not quite as productive as in former years.

Chemin. (Cornell University). Larger than in 1891 and very productive, but too late for field culture. It is one of the most profitable varieties we have under glass.

Cleveland. (*President Cleveland*, Farquhar.)—Large, smooth, red, resembling Perfection, with which it compares very favorably this year. Better than in 1891.

Faultless. (Farquhar).—Although one of the most productive varieties grown, the fruit is too irregular to be of value.

Ignotum. (Cornell University).—One of the best, but not quite so productive this year as some others.

Ithaca. (College Garden, 1891).—One of the most promising purple varieties in our collection. Is worthy the attention of seedsmen.

Long Keeper, (Thorburn).—The good impression formed last year is confirmed. It is one of the best purple tomatoes, though not quite as early as Beauty.

Mitchell. (Gregory).—Large, smooth, red; much flattened and stem set in deep basin. Ripens evenly and is productive. Much better than last season.

Optimus. (Thorburn).—Of medium size, smooth, red; productive. All things considered the most satisfactory variety in our collection this year.

Perfection. (Livingston).—Sustains its reputation as one of the best red tomatoes.

Ponderosa. (Henderson).—Very large, irregular, light purple, resembling Mikado except in foliage. Quality mild and good, but not productive. Rarely more than two or three fruits in a cluster.

Potomac. (Harris).—Large, pink, considerably flattened but not irregular. Not superior to other sorts of this class.

Potato Leaf. (Livingston).—Of medium size, smooth, pink. Plant vigorous and productive. Good.

Red Cross. (Farquhar).—Of medium size, smooth, red. Ripens evenly with little tendency to crack; but like the preceding, rather late.

Richmond. (*Early Richmond*, Landreth).—Large, red, very irregular. Not valuable.

Ruby. (Henderson).—Of medium size, red, angular. Early, but otherwise not valuable.

Stone. (Livingston).—Large, smooth, scarlet, solid. Productive, but late.

Volunteer. (Cornell University).—Of medium size, smooth, red. Plant vigorous and productive. Good.

Yellow Victor. (Gregory).—Of medium size, much flattened, inclined to be irregular. Resembles the old Large Yellow, though somewhat smoother. Of no special value.

The varieties which gave best satisfaction during the past season were: Optimus, Lorillard, Long Keeper, Ignotum, Ithaca, Perfection, Potato Leaf. Stone and Chemin Market are too late for profit. Ponderosa though exceedingly large and of good quality is too irregular and too uncertain to rank high.

Ithaca, which has never been introduced to the trade is a valuable sort worthy of dissemination.

Early Ruby and Atlantic Prize, while early, are not enough superior to other varieties in this respect to overcome the objections as to irregular form.

SUMMARY.

1. The average productiveness of tomato plants, both as regards number of fruits and weight of product, appears to be in direct proportion with the earliness of setting in the field.

2. Little or no benefit seems to be derived from the practice of bagging fruit.

3. Individual variation is such as to render conclusions drawn from a single season's work very unreliable.

4. Crossing between small fruited plants of very prolific habit and the larger fruited sorts, is a promising method of securing valuable varieties, which shall be sufficiently early for the best results.

5. Plants grown from seeds of small fruits—those receiving little pollen—were slightly inferior to those grown from large fruits from the same parent plant.

6. The best variety grown during the season, all things considered, was the Optimus.

7. Among the best varieties for general use are: *Red*, Optimus, Perfection, Ignotum, Lorillard; *Pink*, Potato Leaf, Beauty, Long Keeper; *Yellow*, Golden Queen.

8. Of the newer varieties, Cleveland, Long Keeper, Mitchell and Stone are desirable; while Richmond and Yellow Victor do not appear to be of special value.

III. Notes of Egg Plants.

The egg plant is one of the important vegetables which has as yet received little attention in this State, and the poor withered specimens sent in from other states give consumers little idea of the delicious character of this plant when fresh and well served. No doubt also, the fact that it is not common, and that cooks are not accustomed to serving it, may account to a large extent for its neglect.

The egg plant is a native of tropical America, and reaches perfection only in a warm climate and near the coast. By careful treatment, however, and by a process of acclimatization, it may be successfully grown far inland and much farther north than commonly attempted, as the successful plantings in the college gardens for the past two years abundantly prove.

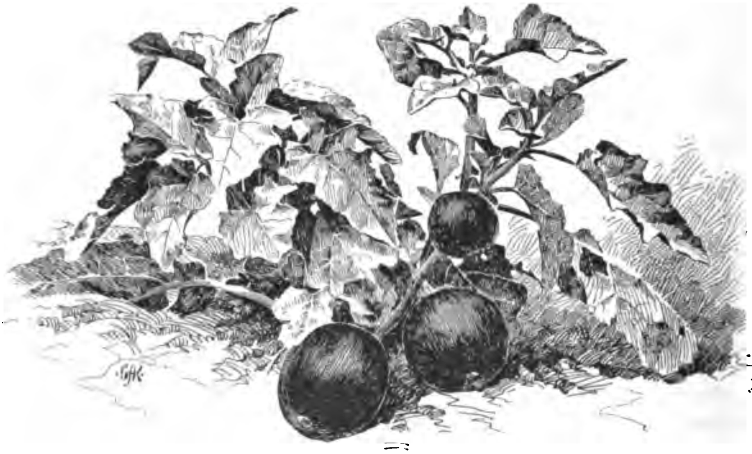

Fig. 3. *Black Pekin.*

The following notes embrace the more important results of our experiences with this plant during the past four years:

1. *Culture:* As a long season is required for the egg plant to mature, it is highly important that the plants be started early. It is our practice to sow the seeds in "flats"—shallow boxes about three inches deep—in a warm forcing house about the middle of March or the first of April. After about a month, or when the first true leaves are nicely started, the young plants are pricked off into other boxes, two inches apart each way, or, better, into 2-inch pots. About three weeks later, when the pots are well

filled with roots, or when the plants begin to crowd, the latter should be shifted to 4-inch pots. We have almost invariably had better success when the plants were handled in pots than when they were transplanted into other flats, the check caused by frequent disturbance of the roots appearing to be detrimental to most sorts. An exception is noted, however, in case of the Early Dwarf Purple which seems able to withstand very harsh treatment.

It is important that the plants be kept growing vigorously from the start, as they seldom fully recover from a check, and in order that fruit mature the plants must be strong and vigorous when planted in the field.

The plants may be set in the field, in this latitude, about June 10th to 15th. We usually set them in rows about three feet apart that they may be cultivated by horse power. The soil should be a rich sandy loam containing an abundance of organic matter. Heavy dressings of stable manure are advisable. Frequent and thorough cultivation are absolutely essential to success.

Perhaps the worst insect enemy of the egg plant is the potato beetle. The tender foliage of the young plants is specially subject to attack, and as the growth is so slow, severe injury nearly always proves fatal. Paris Green, one pound to one hundred gallons of water (about one-half teaspoonful to a large pailful of water), applied about once a week, will be found useful.

2. *Methods of Serving:* No doubt the fact that cooks are not familiar with methods of serving the fruit of the egg plant accounts to a large extent for the failure to use it more. The following recipes for cooking the fruits are given in Bulletin 26 of the Cornell University Experiment Station, and have been found satisfactory:

"1. *Fried.* Cut in slices cross-wise not over a half-inch thick and parboil about fifteen minutes; then remove and fry in a hot spider in butter and lard.

"2. *Fried.* Cut into slices ¼ to ½-inch thick and lay in strong brine for two hours; then wash *very* thoroughly; sprinkle with brown sugar, pepper and salt and fry slowly to a dark brown.

"3. *Baked.* Cut in two length-wise, remove the seeds and pulp and fill with dressing made of half teacupful bread crumbs, one teaspoonful butter, and salt and pepper to taste; lay the halves side to side in dripping pan, add a little water and bake nearly an hour.

"4. *Fritters.* Pare, cut in slices cross-wise and soak in salt water for eight or ten hours; dry on a towel, dip in beaten egg and roll in bread crumbs, then fry slowly in hot butter until the pieces become rich brown; serve hot."

3. *Varieties:* For several seasons we have grown such varieties as we could obtain from all sources. The number of varieties is comparatively limited, but there are several distinct types of varying importance. These types vary in regard to color, size, form, habit of plant and season of maturity. Some from their earliness and productivenss but small size, are valuable only for home use. Others by virtue of their large size and attractive appearance are popular in the markets, but as a rule they are not sufficiently early and productive for the short seasons of this latitude.

The following varieties have been grown in the college garden during the past two seasons and the illustrations are from photographs of plants grown here.*

Black Pekin. (Thorburn).—Plant large and vigorous; stems petioles and veins always deep purple; leaves large, more or less distinctly lobed, purple with metalic lustre above. Fruit large, 5 to 7 inches in diameter,—often larger—spherical or oblate, very dark purple. Entirely distinct from every other variety, rather late but it fruited well the past season. A popular market variety.—See fig. 3.

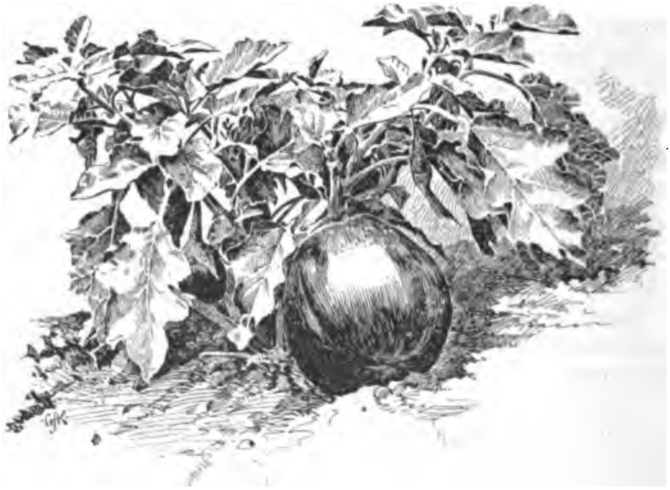

Fig. 4. *New York Improved.*

New York Improved. (Thorburn, Gregory).—Plants large and vigorous, erect; stems, petioles and veins dark green or purplish on upper surface; leaves very large, lobed, downy, with large

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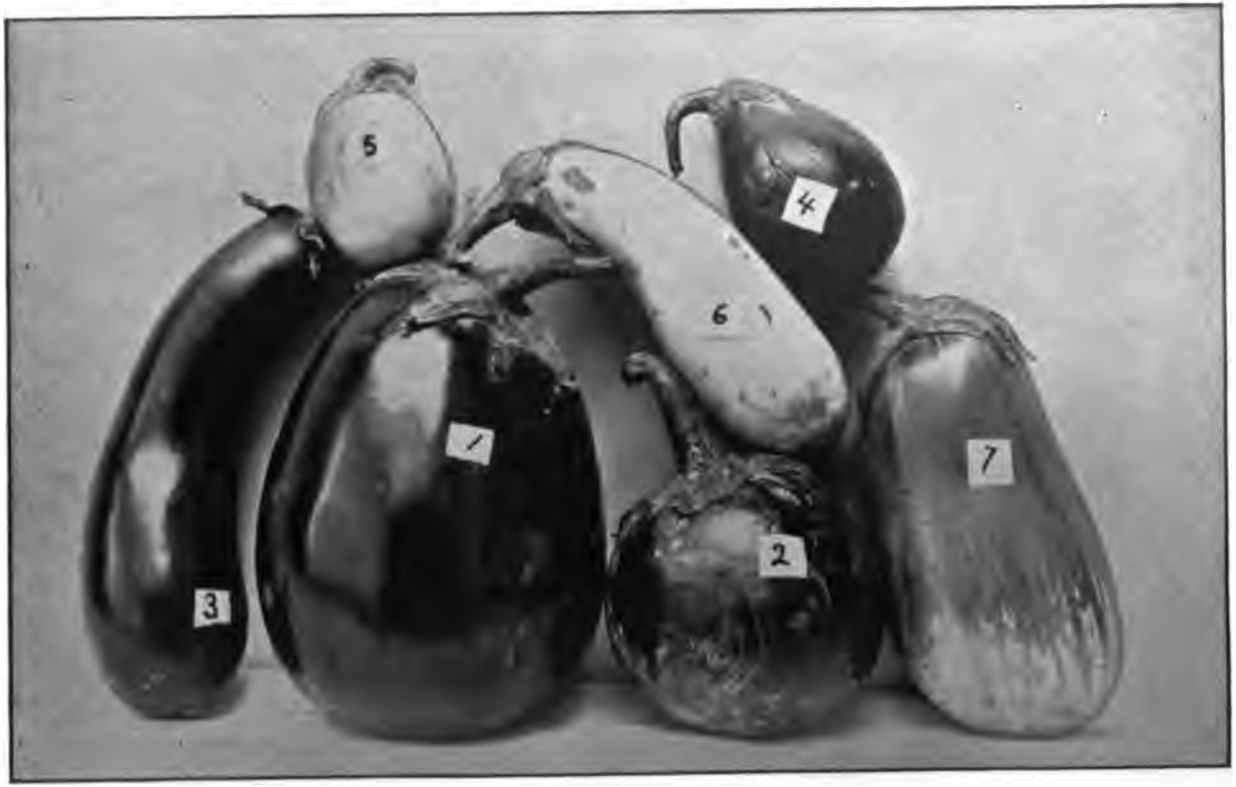
* Cuts for figures 6, 8, 9 and 10 were loaned us by the Cornell University Experiment Station.



TYPES OF EGG PLANTS See page 78.

1. New York Improved. 2. Black Pekin. 3. Long Purple. 4. Dwarf Purple. 5. Round White. 6. Long White. 7. Cross. (B 7 (a) p. 89.)

spines on the mid-rib. Fruit large to very large, oblong, dark purple. The most common market variety, but too late for this latitude. See fig. 4.

Round Purple. (Thorburn, Landreth).—Plant of medium size but vigorous and fairly productive. Fruit small to medium in size, spherical or oblong, pale violet. Its color renders it undesirable.

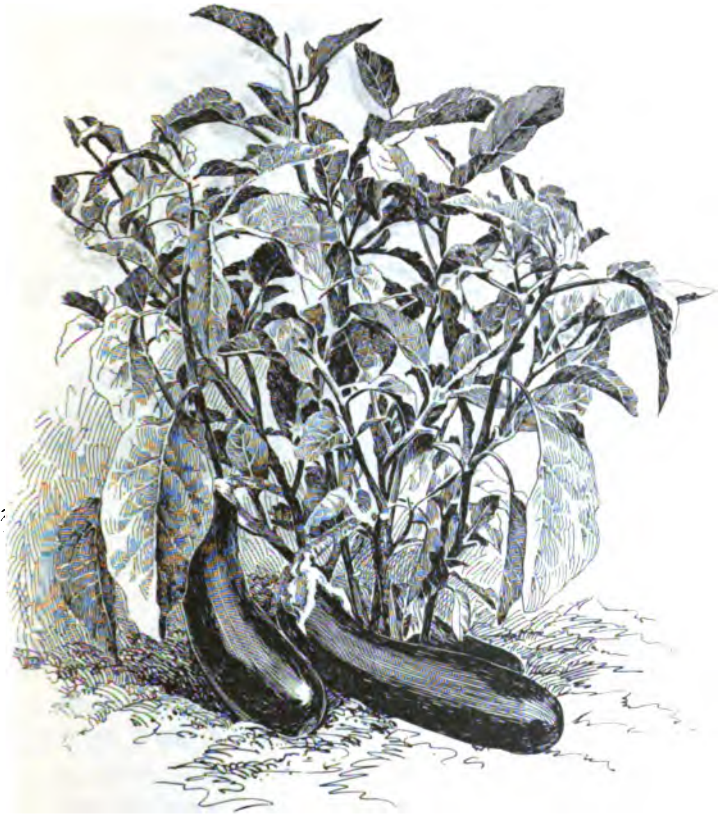


Fig. 5. *Long Purple.*

Early Long Purple. (Thorburn, Gregory).—Plant of medium size, dark green or slightly purplish; leaves medium in size, slightly lobed. Fruit long, club shaped, dark purple, of excellent quality, one of the very best for general culture. See fig. 5.

Early Dwarf Purple. (Gregory).—Plant, low, weak, spreading, spineless; stems and petioles dark purple, slightly downy, leaves small, dark green with purplish tinge. Fruit small—three to six inches long—pyriform, dark purple. The earliest and most productive variety grown; hence perhaps the most valuable for home use. It is too small, however for a market sort. We have found this sort better able to overcome the effects of neglect than any other variety grown, and plants started in a hot bed as late as the first of May have given excellent results. Fig. 6.

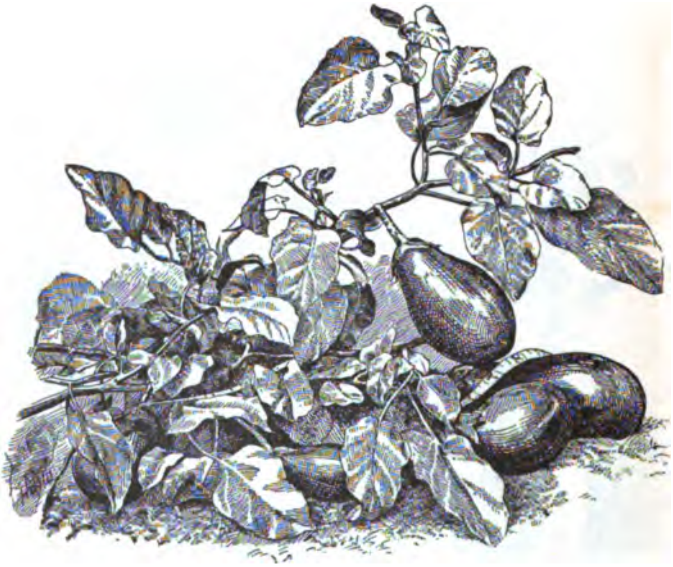


Fig. 6. *Early Dwarf Purple.*

Long White. (Thorburn).—Plant of medium size, erect, light green, downy; leaves of medium size with undulate margins. Fruit long, frequently curved, abruptly rounded at the apex; pure white, becoming yellowish at maturity. A good variety—See fig. 7.

Round White. (Thorburn).—Plant small, upright, bright green; stems, and petioles smooth and shining under a slight covering of down. Fruit small—rarely four inches long—egg shaped, white and like the preceding yellowish, at maturity, very prolific and early, but hard and tough rendering it scarcely edible. Valuable only as an ornament. See fig. 8.

Striped on Guadeloup. (Thorburn).—Plant vigorous, erect, resembling that of Long White. Fruit oblong,—three to five inches long—white with purple longitudinal stripes. Exceedingly prolific, but valuable only for ornament.

4. *Experiences in Crossing*: Our studies of this subject began in 1889, when several crosses were made with the specific purpose of producing new types combining the most valuable features of existing varieties. Some of the earlier results were published in a bulletin from the Connell University, in 1891;* but it will be necessary to repeat some of the statements there made in the present connection.

In 1889 three distinct series of crosses were made. The first of them, which we called *Series A*, was the Round White crossed by pollen from Black Pekin (see figures 8 and 3). These varieties represent two widely different types, and it was hoped we could combine the earliness and productiveness of the former with the beauty of form and color and the excellent quality of the latter.

In the second cross, which we called *Series B*, Giant Round Purple was crossed with pollen from White Chinese. The first of these—figure 9, differs little from New York Purple except in size of fruit which is very large. White Chinese differs little in habit from Long White described on page 80, but the fruits are slightly larger and usually curved, (see figure 10). It is a very handsome variety. These two sorts have not been grown in Maine.

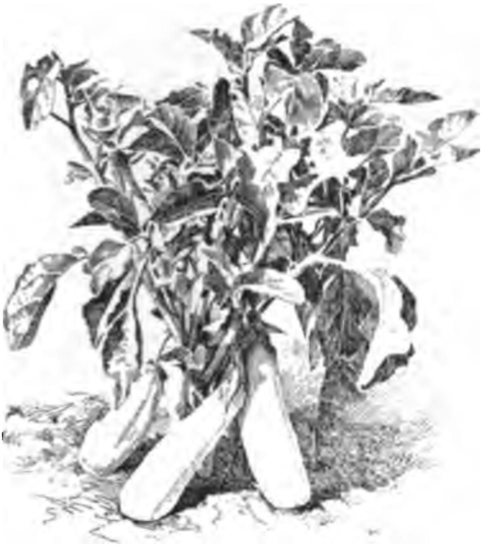


Fig. 7. *Long White.*

In the third cross, *Series C.*, Long White was crossed with Black Pekin. Long White in this case differed from the sort described under that name on page 80, in that the fruit was shorter, being somewhat ovoid in form, while the color was greenish white.

The seeds resulting from all of the above crosses were sown in 1890, and the plants were given conditions as nearly uniform as possible. The plants proved quite variable, and crosses and selections were made in the hope of fixing the more valuable types. Seeds of some of the best of these were brought by the writer to Maine, and were planted in 1891.

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* Bailey & Munson, Bul. 26, Cornell Univ. Exp. Sta., March, 1891.

Following, is a somewhat general account of the results obtained with each series:

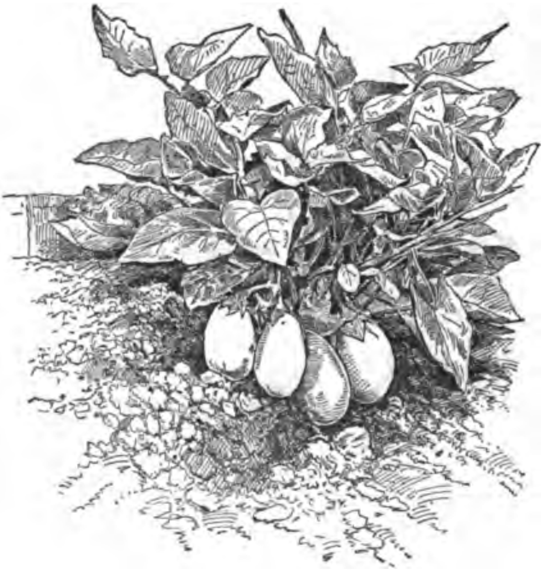

Fig. 8. *Round White.*

SERIES A.

Round White X *Black Pekin.*—One fruit, the result of the first cross, gave in 1890 a series of plants intermediate in general character, between the parents. The young shoots were much like the pistillate parent,—Round White—but as they became older, the upper surface of the stems, the petioles and the veins of the leaves became of the purplish color of the male parent. In form and size, most of the fruits varied in the direction of the pistillate parent. Some were larger, however, and frequently the same plant would bear mature fruits two inches and others five inches in diameter. In color, the fruits were purple while young—usually dark purple with lighter apex. Occasionally this color was retained till time of edible maturity, but as a rule, the dark purple became of a dull greenish cast, while the apex became metallic gray with streaks of grayish purple extending towards the base.

From this first generation, several crosses and selections were made for further study. These were as follows:

A 1. Given pollen from another flower of same plant.
A 2. Given pollen from Round White (female parent).
A 3. Given pollen from Black Pekin (male parent).
A 4. Same as A. 3.
A 5. Same as A. 1.
A 6. Same as A. 1.
A 7. Same as A 2.
A 8. Selection, parentage uncertain.

Of the above selections the fruit was uniformly of the color before described, but varied considerably in size. The general characteristics of the plants were as follows:

A 1. Of the general habit of Round White,—the pistillate parent—but the upper surface of stems, petioles and veins was purple, showing influence of the male parent. Of the four fruits borne, two were the size of a hen's egg, and two much larger—6 inches long.

A 2. Similar to the first, but the purplish tinge less marked.

A 3. Plant strong and vigorous, with upper surface of stems and leaves dark purple.

A 4. Plant vigorous, leaves much larger than with the first three, many of them being considerably lobed, and all of the pronounced purplish cast of Black Pekin. The fruits, however, were shaped like Round White.

A 5. Plant of medium size, bright green. Two fruits of medium size—about six inches long—mostly of two shades of purple, with upper surface dark green. Very mature fruit has yellowish cast of Round White.

A 6. Very similar to A 5.

A 7. Plant of the general type of the series. Fruits of three distinct forms, one like Round White, a second four inches in diameter and like Black Pekin, the third spherical and very small.

As an example of variability induced by crossing, this series is one of great interest. There were no immediate effects of pollen, but we find in the first generation marked indications of the influence of both parents—the habit of the plant and the size of the fruit resembling the female, while the color of the male is apparent.

None of the products of this series promised to be of any commercial value, however, and they were not considered by the writer after leaving Cornell. All of the seeds from each of the individuals treated as indicated on page 84 were sown by Professor Bailey, in 1891, and his comments on the behavior of the resulting plants, as published in a recent bulletin,* are here given:

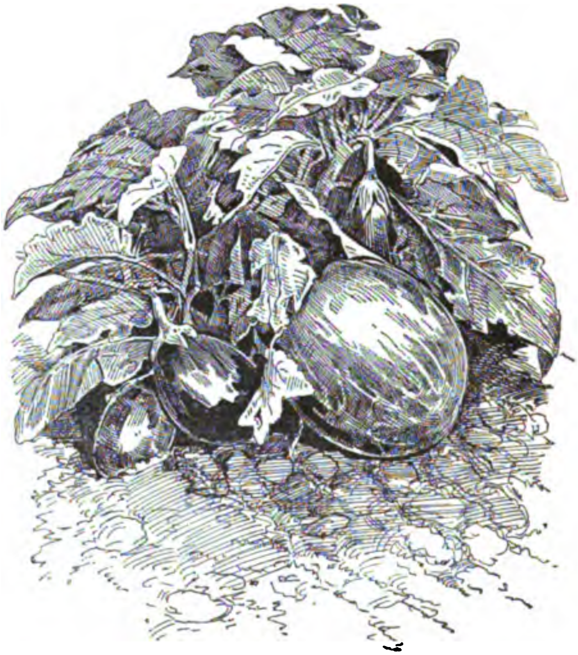

Fig. 9. *Giant Purple.*

"It is interesting to note the influence of Black Pekin in A. 3 and A. 4, into which this variety has twice entered as a staminate parent. All the plants 203, in number, were purple in foliage and like Black Pekin in habit; and most of the fruits were solid purple, although a few striped fruits still showed the influence of the Round White two generations back. The ones into which the Round White entered twice—A. 2 and A. 7—do not show so strongly the marks of the double infusion of blood. In A. 2, there are a few more plants with green, than with purple herbage, and the green ones were more productive than the others; these are marks of the Round White, and it may also be said that even the purple plants were of a light cast, and that nearly all showed the influence of the dwarf habit of Round White. A. 7 the other Round White Cross, produced a lot of small plants, but they were unproductive and much over half of them had purple herbage."

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* Bulletin 49, Cornell University Experiment Station, Dec. 1892.

A 1, A 5 and A 6, pollinated from another flower of the same plant were exceedingly variable. "In fact A 1 was probably the most hopelessly mixed of any in the entire list. The fruits ranged from pure white to green with white stripes, purple striped, light solid purple, and very dark purple; and the mature fruits varied from the size of an egg to that of Black Pekin. About equal numbers of the 175 plants were green and purple. A 5 was nearly as badly mixed, and some plants appeared which had the peculiar spreading habit of Early Dwarf Purple, a variety which had never entered any of the crosses. A 6 showed wide variations also. A 8, which was simply a selection and had not been artificially pollinated, was about as variable as the rest."

It will thus be seen by comparing the characteristics of the plants of the two generations that crossing with either parent served merely to intensify tendencies already existing, and that the use of pollen from another flower of the same plant was apparently ineffectual in serving to "fix" any type.

SERIES B.

Giant Round Purple X *White Chinese.*—This cross resulted in some of the most promising types I have ever grown. The plants, as in series A, were as a rule intermediate in habit and character between the parents. The sturdy, vigorous habit of Giant Purple, the female parent, was exhibited, but the leaves were smaller and less distinctly lobed than in that variety.

In form the fruits, as a rule, resembled the male parent, White Chinese, but they were of greater diameter. The color at edible maturity was rich dark purple with lighter apex. When left for seeds to ripen, the dark purple body of the fruit became of a dull greenish hue, while the lighter apex became gray, then yellowish like the male parent.

As in the first series, a number of individuals were again crossed with the original parents and some of the more promising types were selected without artificial pollination. All of these crosses and selections were grown by Professor Bailey at Cornell University,* and some of those appearing most valuable were brought by the writer to Maine.

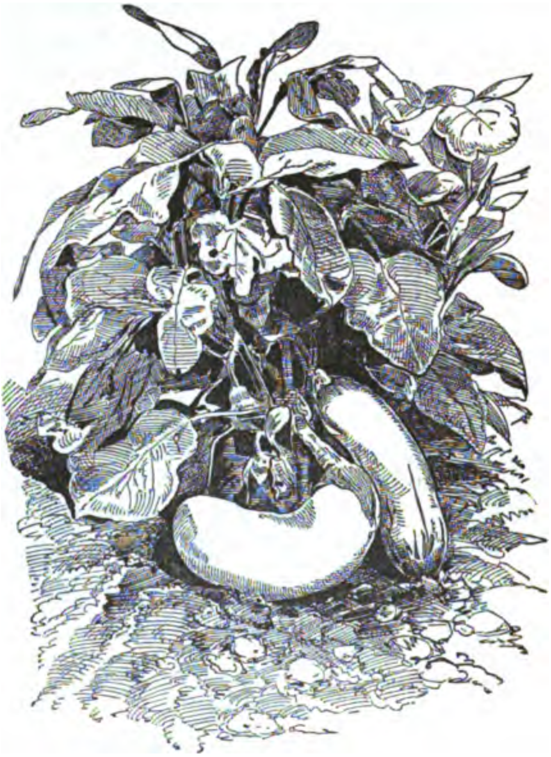

Fig. 10. *White Chinese.*

The parentage of those grown at this station was as follows:

B 1. Crossed by Giant Purple (female parent).
B 2. Pollinated by another flower from same plant.
B 3. Crossed by Giant Purple.
B 5. Crossed by Giant Purple, as in B 1 and B 3.
B 7. Selection, not artificially pollinated.

In every instance these parent fruits were of the general form and color above described. The offspring, however, were exceedingly variable. The plants were of the intermediate type, characterizing those of the first generation, but in the fruits wide differences were noted. B 1 into which Giant Purple has twice entered —first as pistillate, then as staminate parent—still showed the effect of White Chinese in two out of the eight plants grown. As a rule the fruits were dark purple and of greater diameter than the immediate parent, but one fruit while of the form of Giant Purple had the light apex and streaks of the immediate parent, while another was very light purple with green apex and stripes even when very immature.

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* See Bulletin 49 Cornell Univ. Exp. Sta., Dec., 1892.

B 2 which contained no fresh admixture of either parent, showed a marked tendency to revert to the light form. With three exceptions the fruits were much lighter colored than the parent. Two plants bore fruits of a dark green ground color with apex nearly white and dotted and splashed with purple; while another bore very light green fruit with splashes of purple fading to a yellowish green at maturity.

B 3 showed very plainly the double influence of Giant Purple. In no case was the immediate parent perpetuated. The plants were exceedingly vigorous; leaves large, considerably lobed. Fruit ovate—about 6 inches long and 4 inches in diameter—very dark purple, almost black. Two plants bore fruit with lighter apex, but the very light forms seen in B 1 were not present.

B 5 very closely resembled B 3 in form and color but with greater tendency to light apex. The fruits were very handsome—often 9 inches long and 4 inches in diameter. B 7 was exceedingly variable both in form and color—the latter ranging from very dark purple through all gradations to light green with white apex and no trace of purple.

Selections from all of the above types were again made, but most of the fruits failed to ripen and were lost. Those saved were grown the past season and gave the following results: B 1 (a)—a selection from B 1, bearing purple fruits shaped like Giant Purple—retained the form of its immediate parent but was exceedingly variable as to color, many of the fruits being dull green with white apex and stripes, others irregularly splashed and mottled with purple. B 5 (a) also showed a marked tendency to revert to the white form. The parent was in no case perpetuated and no valuable form appeared. B 7 (a)—selected from the light type of B 7 in 1891—in no case gave a suggestion of the purple color of the Giant Purple. The form was oblong-pyriform, about 3 1-2 by 6 inches. Aside from the very small sorts this selection was the most prolific sort grown, but its color would condemn it as a market sort. A specimen of this type is shown as No. 7 in the frontis-piece.

SERIES C.

Long White X *Black Pekin.*—In 1890, the first generation, the effect of the staminate parent was very marked in giving color to the foliage, much more so than was the case in series A in which the male parent was also Black Pekin. The plants were uniformly tinged with purple, and in some instances the color was nearly as dark as in the male parent. The fruit was of intermediate color with the purple predominating, but in form was quite variable. Some individuals resembled the staminate parent, other the pistillate, and others were entirely distinct.

This was the least promising of the series and though four fruits were again crossed or selected, but one, C 4, was brought by the writer to Maine. Of the others, grown at the Cornell Experiment Station in 1891. Professor Bailey reports: "In these lots the fruit pollinated from the same plant, C 1, gave a variable and very unproductive offspring. C 3, into which Black Pekin has gone twice gave only purple fruits."*

C 4 was not artificially pollinated, but was selected because of its excellent form, being almost cylindrical with very abruptly rounded ends. Seeds were sown in 1891 and of the resulting plants only two showed a tendency to perpetuate the type of C 4, and these failed to mature fruit. There was a variation in the direction of both of the original parents but in general the plants were of the type of the previous generation.

Selections were again made, and in 1892, there was almost complete reversion to the original male parent in the habit and color of the plants. They were hardly distinguishable from the plants of Black Pekin in adjacent rows. The form of the fruit, however, was still quite variable.

Conclusions as to Effects of Crossing: As a result of four years of breeding, we have as yet obtained no type sufficiently constant in color to be of commercial value. We have found, however, a marked increase in vigor and productiveness as a result of crossing.

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* Bulletin 49 Cornell Univ. Exp. Sta., Dec., 1892, p. 344.

In the first generation the purple-fruited types seem stronger in their power to transmit color to the offspring than do the white-fruited types; and this law appears to hold whether the purple type is used as the male or as the female parent. In later generations the inherent strength of the white-fruited types appears more strongly than in the first; for in the third generation, after the purple type had twice entered the cross, the effect of the original white parent in imparting color to the fruits was more marked than in the first generation.

In all cases the white-fruited types appear stronger in the power to transmit form and productiveness.

SUMMARY.

1. With careful treatment the egg plant may be successfully grown in Maine. The most important requisites of success are: Early sowing; vigorous plants; late transplanting to the field; warm, rich soil; thorough cultivation; constant watchfulness for the potato beetle.

2. The best varieties for this latitude are Early Dwarf Purple, Early Long Purple, Long White, and possibly Black Pekin. Other large varieties are too late.

3. The chief advantage derived from the crossing of the different races of egg fruits appears to be in the increased vigor and productiveness of the offspring. No valuable market sorts have as yet been developed.

FRUIT TESTS.

The winter of 1891-2, was very mild and little injury was done in the fruit plantations. All varieties made a good growth during the season, and as far as practicable the vacancies in the orchard, caused by the previous severe winter, were filled. Several additional varieties of pears, also of cherries were obtained, and a plum orchard has been established. The small fruit plantation has also been largely increased in extent.

The fruit plantations are now systematized, and maps and well defined forms for records have been constructed, thus rendering the plantations more valuable, for purposes of study and avoiding danger of confusion.

The additions to the experimental orchards and small fruit gardens the past season consist of the following:

Apples 5 varieties; pears 8 varieties; plums 13 varieties; blackberries 2; currants 3; dewberries 1; gooseberries 2; raspberries 11; strawberries 14.

With the exception of a few varieties of raspberries and blackberries, there is as yet no basis for a comparison of the merits of different varieties for this region. As soon as the various sorts come into bearing, more detailed reports may be made for the benefit of planters.

The work of securing valuable sorts that will stand the trying climate of the northern part of the state is being continued on an extended scale. During the past season cions of the following varieties have been sent to Perham, Aroostook Co.: Arthur, Borst, Duchess Seedlings number 4 and number 8, North Star, Patten's Greening from C. G. Patten, Charles City, Iowa; Daisy, Gideon number 6, Malinda, McMahon, Okobena, Ostrakoff, Patten's Greening and Utter from J. S. Harris, LaCrescent, Minnesota; Hibernal, Korsk Annis, Red Queen, Repka from Wm. Somerville Viola, Minnesota; Palouse from Geo. Ruedy Colfax, Wash; Rolfe, Maine State College.

Besides the above named cions, two year old trees of the following varieties were kindly donated by the Jewell Nursery Co. of Lake City, Minn. Thompson's seedlings numbers 24, 26, 29, and 43. As was the case last season part of these cions were set in bearing trees and part in seedling stock raised from Duchess seed.

The season was a favorable one for young stock, and all varieties made a vigorous healthy growth. None of them were taken up in the fall, and as the present winter is a very severe one with little snow, the test as to hardiness will be a crucial one.

The following varieties of Russian plums, purchased from the Iowa Agricultural College in 1891, were also placed on trial the present season: Bessarabian, Early Red, Hungarian Prune, Moldavka, Orel Sweet, Varonesch Yellow, White Nicholas, Nos. 19, 20 and 23 Orel; besides these one tree each of Cheney, Wolf and and Wyant from the same source and Rollingstone from O. M. Lord, Minnesota City, Minn. All of these last named sorts are valuable varieties of the hardy native *Prunus Americana*, originating in the trying climate of the northwest. It is our purpose to increase the list of plums next season and if possible by crossing some of these very hardy sorts with others of higher quality secure desirable sorts which shall rank with Moore's Arctic as a profitable variety for this region and possibly shall not require the winter protection demanded by that variety.

There is little doubt that with proper management small fruits might be made even more profitable in the northern parts of the State than in the southern, as at this latitude the crop ripens so late as to escape more southern competition. With this end in view, a number of varieties are being introduced. Some are already grown at Houlton—notably the Houghton gooseberry and the Agawam blackberry, but so far as I can ascertain little is being done even in the home gardens of northern Maine toward raising other small fruits.

Last spring plants of Windom and Lucretia Dewberry and of North Star Currant were sent to Perham for trial. Others will be sent later.

At the present time an effort is being made to determine the exact status of the fruit industry in the State, especially in the more southern portions, that we may have a basis for intelligent work in developing this line of work. A report on this subject will be published during the ensuing year.

SPRAYING EXPERIMENTS.

The work of spraying to prevent the attack of the apple scab was continued on the same line as last year, both Mr. C. S. Pope of Manchester and Mr. C. E. Moore of Winthrop, co-operating. The season was very unfavorable and it was difficult to find a suitable time for the work. In nearly every instance rain fell within twenty-four hours after the spraying was completed. As a result, the effects of the fungicides were somewhat modified and were less striking than those obtained last year.

Results in Mr. Pope's Orchard.

In Mr. Pope's orchard the work was of sufficient extent to warrant very free conclusions from a commercial point of view. The orchard is situated on a gravelly hill-side having a northwestern exposure and has been very subject to the attack of the fungus for some time.

The main object in view in this work was to determine the relative values of different solutions and to study the effects of applying the mixture at different times.

To this end, instead of single trees, given different treatment, contiguous rows extending down the hill-side were selected. In this way all rows presented essentially the same conditions, part of the trees being on high land and part on low. This matter of location is of the highest import since it has been observed—in this orchard and some others I have studied—that trees on high exposed situations are apparently more subject to attack than are those on lower ground.

Three solutions were used in the test as follows:

Solution A. Modified *eau celeste*, consisting of two pounds copper sulphate, two and one-half pounds carbonate of soda, one and one-half pints ammonia and thirty gallons water.

Solution B. Five ounces carbonate of copper, three pints strong ammonia, fifty gallons water.

Solution C. Three ounces carbonate of copper, one pound carbonate of ammonia, fifty gallons water.*

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* For directions as to preparation of mixtures see Rep. Maine Ex. Sta., 1891, p. 116.

To be doubly sure of results, duplicate series were used. In this way we have two rows in different parts of the orchard sprayed with each solution; while for comparison three rows alternating with these were left without treatment. Naturally all of the trees were not equally productive, and in counting the fruit only those trees which were under approximately the same conditions were selected.

Because of the large number of trees to examine it was impossible to count all of the fruit from each tree, hence five basketfulls, or two and one-half bushels were taken from all parts of each tree.

Table VIII gives the results obtained from the first series, and table IX those from the second.

TABLE VIII.

Solution.	Average number fruits examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Per cent. free.	Per cent. No. 1 apples (as regards scab).	Remarks.
"A"	563	219	332	14	39.00	97.6	Average of four trees.
Check	681	0.6	203	477	0.09	30.1	" " five "
"B"	550	47	410	93	8.50	83.7	" " " "
"C"	663	24	429	209	3.73	68.6	" " " "
Check	663	0.6	207	425	0.12	35.5	" " " "

TABLE IX.

Solution.	Average number fruits examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Per cent. free.	Per cent. No. 1 apples (as regards scab).	Remarks.
Check	633	0.6	207	425	0.12	35.5	Average of five trees.
"A"	552	123	361	67	23.6	88.3	" " four "
"B"	637	12	290	336	2.1	49.8	" " three "
Check	556	17	324	215	3.1	62.1	" " four "
"C"	535	46	388	101	8.9	81.7	" " three "

The superiority of the fruit on trees treated with solution *A*—modified *eau celeste*—is seen at a glance; while solutions B and C do not appear widely different. With a single exception the average increase of marketable fruit as a result of the treatment ranges from 19 to 60 per cent. Row "B" in table IX was a short row and contained one tree which was very badly attacked—only 27.6 per cent. of the fruit being "No. 1"—thus bringing the average below that of the adjoining check row, which was better than the average.

Combining the results obtained in the duplicate trials, these facts stand out even more clearly, as seen in table X.

TABLE X.

Solution.	No. examined. Average per tree.	Free from scab. (Average).	Slightly scabbed. (Average).	Badly scabbed. (Average).	Per cent. free. (Average).	Per cent. No. 1 apples (as regards scab). (Average).	Remarks.
"A"........	559	171	347	41	30·1	93·0	Average of 8 trees.
"B"............	583	34	365	184	6·1	71·0	" " " "
Check..........	615	32	414	169	5·6	73·5	" " " "
"C"............	628	5	239	384	0·93	41·2	" " 14 "

As will be observed, the average proportion of "No. 1" fruit on unsprayed trees—considering fourteen trees in all parts of the orchard—was only 41.2 per cent. of the crop; while the average proportion on trees sprayed with the least effective solution was 71 per cent., a gain of nearly 30 per cent. With the modified *eau celeste* this difference was much more marked, amounting to nearly 52 per cent., or a saving of more than half of the total crop.

The amount of fruit absolutely free from scab is not as large as might be wished; but the standard adopted in sorting the fruit was very rigid, and much of that classed as "slightly scabbed" was in reality better fruit than that classed as "free." It was observed, however, that fruit from the trees sprayed with *eau celeste* were frequently russetted, as though the solution was too strong.

With these figures in view, and considering the fact that the results are in direct confirmation of those obtained last year, there would appear to be little doubt as to the effectiveness of the treatment when the work is properly conducted.

The value of duplicating any experiment of this kind is well shown by comparing tables VIII and IX. Table VIII gives data which would apparently warrant drawing very positive conclusions as to the relative merits of the different solutions; while table IX would appear to reverse the relative positions of solutions "B" and "C," and even indicates that solution "B" is of little if any value. But by combining the data we approximate nearly the true results.

When Shall we Spray? A part of the work in Mr. Pope's orchard was conducted with a view to determining the best time for applying fungicides, as well as the relative value of several applications. To this end some trees were sprayed but once, early in the season; others were sprayed twice, some three times and some four times; while some trees were not sprayed. Solution "B" was used in every instance.

The results of this trial are shown in table XI.

TABLE XI.

No. times sprayed.	Number fruits examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Per cent. free.	Per cent. No. 1 apples (as regards scab).	When sprayed.
Once..................	499 497 481 604 600	13 1 12 0 4	314 161 301 212 267	172 335 168 392 329	2.6 0.2 2.5 0.0 0.7	65.6 32.6 65.1 35.1 45.2	May 26.
Average per tree..	536	6	251	279	1.2	48.7	
Twice................	688 610 542 556	0 2 26 0	287 314 355 237	401 294 161 319	0.0 0.3 4.8 0.0	41.7 51.8 70.3 42.6	May 26, June 23.
Average per tree..	599	7	298	294	1.3	51.6	
Three times..........	583 617 684 485	30 38 27 36	439 455 432 360	114 124 225 89	5.1 6.2 3.9 7.4	80.3 79.9 67.1 81.6	May 26, June 23. July 21.
Average per tree..	592	33	421	138	5.6	77.2	
Four times...........	588 438 552	21 45 18	346 292 372	221 101 162	3.6 10.3 3.2	62.4 76.9 70.6	May 26, June 23, July 21, Aug. 20.
Average per tree..	526	28	337	161	5.7	70.0	
Three times..........	559 707 462	6 7 25	315 285 300	238 415 137	1.1 1.0 5.4	57.4 41.3 70.3	June 23, July 21. Aug. 20.
Average per tree..	576	13	300	263	2.5	56.3	

There is a very noticeable difference in the percentage of good fruits on adjacent trees when treated in the same manner. But trees sprayed three or four times are more uniformly good than those sprayed once or twice. As seen in the table, in the row sprayed once, there is a difference of more than 32 per cent. in the amount of fruit on the second tree, and that on the trees on either side—a difference frequently noted on the unsprayed rows. In the rows treated twice this difference is not quite so marked; while in the rows sprayed three or four times the greatest difference is only about 14 per cent., the lowest percentage being nearly equal to the highest on the trees sprayed but once.

By comparing the last division of the table with the third, it will be observed though each row was sprayed three times the average quality of the fruit is much lower in the former case, the average per cent. of No. 1 fruit being 56.3, as opposed to 77.2 in the third row. That is, the indications point strongly to the value of spraying *early*. The two rows in question were under essentially the same conditions, being parallel and separated by only one row, which was sprayed four times, but the first was sprayed once before the blossoms opened, while the other was not sprayed till June 23.

The results obtained are not conclusive, but in general they point to the value of repeated applications and to the desirability of spraying early in the season.

Results in Mr. Moore's Orchard.

To check our work still further, arrangements were made with Mr. C. E. Moore of Winthrop to continue the work of the previous year in this direction. Mr. Moore's orchard is usually very badly attacked, and would seem to be an excellent field for work. The trees bore very heavily in 1891, however, and were not as well adapted for our use as they otherwise would have been. Those trees which bore but little fruit are not considered in compiling the tables, as such trees are seldom attacked so severely as are those which bear a full crop. As will be observed, the character of the fruit on the different trees is very unequal; that on some trees being either excessively scabby or remarkably free from scab, while that on other adjacent trees may represent the opposite extreme. Thus it follows that the average percentages as given in the tables do not always represent the true average condition of the trees, especially is this the case when a larger number than common is taken from any one tree. As before noted, however, the amount of fruit was so variable, that in order to get proportionate quantities from the different classes, it was impossible to adopt an inflexible rule as in the first orchard considered.

But two solutions were used in Mr. Moore's orchard viz: Solutions "B" and "C" described on page 92.

In comparing the two solutions a number of trees were sprayed four times each, on May 26, June 15, July 15, and Aug. 15, or as near these dates as possible. Rain followed soon after each application, and the results are not striking, as seen by table XII.

TABLE XII.

Treatment.	Number fruits examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Worthless.	Per cent. free.	Per cent. No. 1 apples (as regards scab.)	Remarks.
Solution "B"....	1892	8	829	797	348	0.4	42.2	Always one of the worst in the orchard. Very full; fruit small; ½ of whole counted.
Sprayed 4 times.	839	138	496	183	25	16.4	75.2	All the fruit taken. Opposite Check No. 3.
	456	28	359	61	8	6.1	84.9	All the fruit.
Average.........	**1092**	**58**	**560**	**347**	**127**	**5.3**	**56.6**	
Checks...........	577	9	318	227	23	1.6	56.7	Small tree; light crop.
	2334	6	1175	927	226	0.3	56.0	All the fruit counted; opposite No. 1, solution *B*.
	1006	0	415	565	26	0.0	41.2	½ of all counted.
Average.........	**1306**	**5**	**636**	**573**	**92**	**0.4**	**49.1**	
Solution "C"....	522	6	246	224	46	1.1	48.3	All the fruit.
Sprayed 4 times.	854	24	415	382	33	2.8	51.4	½ of all.
	1047	20	542	469	16	1.9	53.7	½ of all.
Average.........	**808**	**17**	**401**	**358**	**32**	**2.1**	**51.7**	

As will be observed the average results are slightly in favor of the sprayed trees as compared with the unsprayed, while solution B gave slightly better results than did solution C, the average increase in No. 1 fruit being 5.5 per cent. in the former case and 2.6 per cent. in the latter. The percentage of fruit absolutely free from scab is very low in every instance, but in a general way the work has some value in that it confirms the results obtained in Mr. Pope's orchard.

Number of Applications.

Some of the trees in Mr. Moore's orchard were sprayed twice with solution B, and others three times, while others in close proximity were left as checks. Trees sprayed four times were under somewhat different conditions and can not be compared with these.

Table XIII shows the results obtained from this trial.

TABLE XIII.

No. times sprayed.	Number fruits examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Worthless.	Per cent. free.	Per cent. No. 1 apples (as regards scab).	Remarks.
Twice........	696	28	452	195	21	4.0	68.9	All the fruit counted.
	917	35	620	252	10	3.8	71.4	About ⅓ the fruit. Adjacent to first tree sprayed three times.
	529	231	278	30	00	42.9	94.5	All the fruit.
Average............	**717**	**98**	**450**	**159**	**10**	**13.7**	**76.4**	
Three times.......	833	73	574	168	18	8.8	77.7	All the fruit.
	787	78	491	206	12	9.9	72.3	¾ of all; very good.
	970	55	764	151	00	5.7	84.4	About half; small.
Average............	**863**	**69**	**610**	**175**	**10**	**8.0**	**78.3**	
Checks........	1006	00	415	565	26	0.0	41.2	¾ of all.
	839	38	485	265	51	4.5	62.3	All the fruit.
	774	98	531	120	25	12.7	81.3	" " "
Average..... ...	**873**	**45**	**477**	**317**	**34**	**5.1**	**59.8**	

A single tree in the first group being exceptionally free from scab, the average percentage of fruits absolutely free is brought higher than in the other cases; but the average proportion of fruit which would be classed as "No. 1" is greater on those trees which were sprayed three times. With a single exception the amount of "No. 1" fruit on all sprayed trees is considerably greater than that on unsprayed trees, the average increase being 16.6 per cent. on trees sprayed twice, and 19 per cent. on those sprayed three times.

SUMMARY.

1. Spraying with copper solutions proves an effective means of checking the apple scab.

2. The average increase in the amount of salable fruit on the trees sprayed with the least effective solution over that on the unsprayed trees was 30 per cent. while the increase on trees sprayed with *eau celeste* was nearly 52 per cent.

3. *Eau celeste* proves more effectual than does the ammonio-copper carbonate solution but as used there was a slight injury to surface of the fruit.

4. Indications point strongly to the value of spraying early in the season, before the blossoms open.

5. Repeated applications of the fungicide during the season are beneficial.

Report of Botanist and Entomologist.

PROF. F. L. HARVEY.

PROF. W. H. JORDAN.

Dear Sir:—I have the honor to submit herewith my fifth annual report as Botanist and Entomologist for the Experiment Station. Judging from the number of letters received the past season, asking questions about plants, insects, fungicides and insecticides, there is an increased demand on the part of farmers in the State, for information upon Economic Botany and Entomology. Below will be found tabulated the more important plants and insects that have received attention during the past season. Those requiring more than a passing notice are considered in detail, and so far as necessary illustrated.

The past season has been somewhat remarkable because of the appearance in the State in injurious numbers of several insects that have not before been reported, viz: The Corn or Boll worm, which was found in the vicinity of Farmington feeding on sweet corn; the Chinch Bug, doing great damage to grass grounds in the vicinity of N. Fryeburg; the Horn Fly which proved quite annoying to cattle in the western part of the State, and *Bruchus obtectus*, *Say*, the Bean Weevil, boring in stored beans after the manner of pea weevils in peas.

We stated in our report for 1891, that the Fall Canker Worm had been increasing in the Penobscot valley for the past four years, and that considerable trouble might be expected from it in the future. It has proved very troublesome the past season about Winterport, Bowdoinham and Stockton, doing great damage to fruit and shade trees. We learned through a Vermont correspondent that the Apple Maggot, *Trypeta pomonella*, Walsh, infests pears in that State. As we have never seen it working in pears in Maine any information on the subject from Maine orchardists will be appreciated. We received specimens of the Melancholy Cetonia (*Euphoria melancholica*,) from Mr. John A. Smedberg, Unity, which were eating sweet corn at the top of the ear. So far as we know this habit has not been recorded. The Oyster-Shell Bark-louse must be doing great damage in Aroostook County judging from the badly infested specimens of apple twigs received from David Crane of Houlton. Those interested in this insect will find it considered in Expt. Sta. Rept. 1888, p. 157.

The Three-toothed Aphonus, accused of cutting corn in our last report, has been fully convicted of the charge the past season, by Mr. C. V. Manley of Auburn. He says, "I found this beetle which I send you, in a hill of corn with his head in a cut in the side of a stalk that had begun to wilt."

Mr. E. W. Merritt of Houlton, reports that he keeps the plant lice on his gooseberry bushes in check by removing the twigs bearing curled leaves in the fall. We have received insects during the past season from Illinois and California sent for determination by the editor of the Maine Farmer. Investigation of a species of mite called by us the Two-spotted Mite has been continued. This mite has done considerable damage the past season in the greenhouse at the college, and we found it had almost entirely destroyed a patch of German Wax Beans in our garden. Should it prove able to injure to any extent out of door plants, its capabilities of doing damage would be greatly enhanced. As we were doing laboratory work on the mite, it might have been carried to the beans on our clothing. We wish to study the coming season, insects affecting currant and gooseberry bushes, and will be pleased to receive specimens from all parts of the State.

We received from Mr. Ira Porter, Houlton, Maine a bunch of clover, *Trifolium medium*, L., in which the heads had assumed the form of conpound umbels. This was interesting as a confirmation of the belief by botanist, that the head, a kind of inflorescence found in the clover, is an umbel with the axis of inflorescence and the pedicils, shortened. Mr. Henry Sprague of Charlotte, for whom we examined some mosses last season in reference to their value as food for swine, reports that he fed during the winter about six barrels of *reindeer moss*, four of *hypnum splendens*, two of *sphagnum cymbifolium*, to three *swine*. As the pigs all had other food he had no definite way of telling how much nutriment they got from the mosses. Thinks they liked either of the others as well as the reindeer moss. Thinks all had a constipating effect, which he overcame by liberal doses of sulphate of magnesia (salts).

Mr. W. H. Burgess of Monroe, says, that he grafts the Arctic and Lombard plums into the common Pomgranite and avoids the black knot, which has proved so destructive to plum trees in general. We don't know how thoroughly the experiments were tried, but have serious doubts about its being a protection. We doubt whether any of the varieties are exempt from this disease, though we admit that such a variety would be a great blessing to plum growers. We received from Mrs. Myra Damon, Newport, Maine, a specimen of Stinkhorn found in a cistern. These plants grow in decaying organic matter and are often found about sink spouts, drains and other places where decomposing organic matter occurs. They may be known by their curious habit of growth. At first they look like a puff-ball, finally the top bursts and from it comes a large spongy stipe which bears at the apex a slimy mass of brownish offensive spore bearing matter. The bottom part (utricle) of the form sent is about as large as a filbert, the stipe pink and three or four inches long. Finding it about the cistern would lead one to suspect that a sink spout or drain was too near, and that the water might be contaminated by it. These fungi are poisonous, but a single one in a cistern would not render the water harmful. Too great care cannot be exercised in placing drains and sink spouts where they cannot possibly contaminate water supply, as decomposing organic matter in drinking water is a very common source of diseases.

Samples of sage sent by Mr. Willard Lothrop, of Leeds Centre for examination as to adulterations, proved to be free from foreign matter, but were composed largely of old stems and poorly cured and blackened leaves. As to color and richness of flavor, the material was quite inferior, and would give dark color and poor flavor to sage cheese.

Walter M. Haines M. D., of Ellsworth, sent us some specimens of Fresh water cord Grass, and asked whether they were not Wild Rice. Wild Rice was sown quite largely in the marshes and ponds of Maine some years ago to attract water fowl, but so far as we know it has not become established in the State. If any one knows of its occurrence in the State, we would be glad to learn the localities. Mr. Fernald gives it in his Portland Catalogue as indigenous to the State, but we do not know the locality.

The Orange Hawkweed is spreading rapidly in the State and threatens to be a serious pest in meadows and pastures. Farmers should study the description given in this report, and be prepared to recognize the pest as soon as it appears, and destroy the straggling plants before they form large patches hard to manage. Below we give an extended account of the most important plants that have claimed attention during the past season.

The Potato Rot has been quite bad in the State the past season. We hope that potato growers will see the importance of using Bordeaux mixture to hold this disease in check. It has proved a great help in other States when applied at the time, or just before the disease makes its appearance.

REMARKS.

The cuts and plates to illustrate this report were obtained from the following sources: from the Department of Agriculture, Washington, D. C.; Cuts of the Orange Hawkweed, and of the Horn Fly. From Prof. S. A. Forbes, cuts of the Corn Worm and Chinch Bug. From Prof. F. D. Chester, cuts showing the results of spraying against Pear Leaf Blight. Plate II. is original.

Directions for sending specimens will be found in the Annual Report of the Experiment Station, 1888, p. 194, or in Maine Agricultural Report, 1888, p. 158. Correspondence regarding injurious insects and fungi is invited. Insects and plants will be named, and when injurious, remedies suggested. It is to the interest of farmers to detect injurious insects and fungi before they become established, so that remedial measures can be adopted before the pests are beyond control. As the Entomologist's duties prevent him from going much about the State, it is largely through correspondence that the Station learns of insects doing injury in the State.

Insects Reported and Examined—1892.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Cecropia Emperor Moth.	Platysamia Cecropia, Linn.	Ross C. Higgins, Thorndike. M. H. White, Bowdoinham.	Cocoons attached to branches of apple trees. See Ex. St. Rept. 1890, p. 121.
2	Fall Canker Worm.	Anisopteryx pometaria, Harris	M. H. White, Bowdoinham. Hon. F. Atwood, Winterport. Freeman Partridge, Stockton.	Eggs attached to apple trees, larvæ upon foliage, male and female moths about orchard. See Ex. St. Rep. 1888, p. 160.
3	Fall Web-worm.	Hyphontria cunea, Drury, = H. textor, Harris.	Ross C. Higgins, Thorndike.	Foliage of apple trees making a web at the ends of the branches. See Ex. St. Rept. 1890, p. 124
4	Corn or Boll-worm.	Heliothis armigera, Hub.	J. M. S. Hunter, Farmington. D. H. Knowlton, Farmington.	Boring through the husks and eating the kernels from the cobs of sweet corn.
5	Melancholy Cetonia.	Euphoria melancholica, Gory.	John A. Smedburg, Unity.	Eating sweet corn at the top of the ear.
6	Three-toothed Aphonus.	Aphonus tridentatus, Say.	C. V. Manley, Auburn.	Cutting off stalks of sweet corn in the hill. See Ex. St. Rept. 1891, p. 199.
7	Plum Curculio.	Conotrachelus nenuphar, Herbst.	H. T. Cummings, S. Paris.	Pears badly punctured by this insect. See Ex. St. Rept. 1888, p. 178.
8		Pasimachus species.	Ross C. Higgins, Thorndike.	On the ground; a beneficial species feeding on other insects.
9	Scabrous Osmoderma.	Osmoderma scabra.	Ross C. Higgins, Thorndike.	Found on an apple tree. Larvæ bore in apple trees.
10	The Squash Bug.	Anasa tristis, De Geer.	S. Dill, Soquel, Cal.	Feeding on squashes.
11	The Chinch Bug.	Blissus leucopterus, Say.	W. B. Nutter, B. Walker McKeen, Simeon Charles, N. Fryeburg.	Destroying Timothy meadows.
12	Currant Worm.	Nematus ventricosus, Klug.	H. H. Osgood, Blue Hill.	Eating foliage of currant bushes. See Ex. St. Rept. 1888 p. 182.
13	Oyster-shell Bark-louse.	Mytilaspis pomorum, Bouchè.	David Crane, Houlton.	Badly infesting the branches of apple trees. See Ex. St. Rept. 1888, p. 157.
14	The Horn Fly.	Haematobia serrata.	Hon. B. W. McKeen, Augusta.	Troublesome to cattle.
15	Two-spotted Mite.	Tetranychus 2-maculatus, n. sp.	Prof. L. H. Bailey, Ithaca, N. Y., and others.	A bad pest in hot houses and also affecting house plants and sparingly out of door plants.
16	Wood Louse, or Sow Bug.	Porcellio species.	Henry R[illegible]ffe, Orono.	Mistaken for the Buffalo Carpet Beetle. Lives on decaying wood and organic matter.
17	Long Horned Wood-borer.	Monohammus titillator, Fabr.	O. F. Brigham, Newport.	A wood borer.

PLANTS RECEIVED FOR EXAMINATION—1892.

No.	Common Name.	Scientific Name.	From Whom Received.	Remarks.
	WEEDS.			
1	Fall Dandelion.	Leontodon autumnale, L.	Henry Norcross, Augusta.	Weed in meadows.
2	Orange Hawkweed.	Hieracium aurantiacum, L.	Geo. W. Chamberlain, Calais. H. L. Leland. E. Sangerville. G. S. Paine, Winslow.	Weed—meadows, roadsides and pastures.
3	Canadian Hawkweed.	Hieracium Canadense, Michx.	I. T. Merrill, China.	Border of fields; not a bad weed.
4	Knapweed.	Centaurea nigra, L.	I. T. Merrill, China.	Weed in fields; should be looked after.
5	Rabbit-foot Clover.	Trifolium arvense, L.	I. T. Merrill, China.	Weed—roadsides, etc.; very common in Maine.
	GRASSES.			
6	Red Top.	Agrostis alba, L. Var. vulgaris. Thurb.	S. H. Berry, Wayne.	Sold by Parker & Wood. Boston, as Kentucky Bluegrass. (*Poa pratensis*, L.)
7	Freshwater Cord-grass.	Spartina cynosuroides, Willd.	Walter M. Haines.	Sent to learn whether it was wild rice.
8	Orchard Grass.	Dactylus glomerata.	Joseph F. Warren, W. Buxton.	Growing in grass ground.
	FUNGI.			
9	Pear Leaf Blight.	Entomosporium maculatum, Lev.	Arthur D. Moore, Portland.	Parasitic on leaves of pear trees causing them to curl, turn red and drop; a bad disease.
10	Hair Mold.	Phycomyces nitens.	N. H. Martin, Fort Fairfield.	Growing on excrement of cats in a potato hill. Not of special economic importance.
11	Anthracnose.	Glæosporum venetum, Speg.	Chas. S. Pope, Manchester.	Raspberry bushes badly infested.
12	Anthracnose.	Glæosporum venetum, Speg.	H. H. Osgood, Blue Hill.	Affecting Shaffers Colossal Raspberry.
13	Stinkhorn.	Mutinus Ravenelii, (B. and C.) Fisch.	Mrs. Myra Damon, Newport.	Found in a cistern. An offensive, poisonous species.
	MISCELLANEOUS.			
14	Zigzag Clover.	Trifolium medium, L.	Ira J. Porter, Houlton.	Heads changed to compound umbels Flowers malformed and dwarfed.
15	Golden Rod.	Solidago squarrosa. Muhl.	E. F. Hitchings, Bucksport.	Sent for verification.
16	Golden Rod.	Solidago latifolia, L.	E. F. Hitchings, Bucksport.	Sent for verification.
17	Aster.	Aster acuminatus, Mx.	E. F. Hitchings, Bucksport.	Sent for verification.

BOTANY.

FALL DANDELION.
Leontodon Autumnale, L.
(Ord. Compositæ.)

The above species continues to be reported as troublesome in grass lands. It has a firm hold in the State, and should be known by farmers so they can check it before a whole field is overrun. When there are only a few plants, the extermination is a simple matter, but if neglected serious trouble will follow. Much of the clover seed offered for sale in this State contains the seed of this weed.

The following reply to Mr. Henry Norcross may interest others.

Mr. Henry Norcross of this city, brought a specimen plant to this office for identification. He says his fields are infested with it, and that it is killing out the grass far and near. We forwarded the sample to Prof. Harvey, Botanist at the Experiment Station, who kindly forwarded the following to the *Farmer:*

The plant you enclose for determination belongs to the sunflower family (*Compositœ*) and is called by botanists, *Leontodon autumnale*, *Linn.* Its common name is Fall Dandelion. The Latin name means the *Liontooth that blooms in the autumn.* The leaves are incised, suggesting the name of liontooth. The plant is a native of Europe, but is thoroughly naturalized in the United States, and quite widely spread. It is especially plentiful in New England, and a bad weed. Being an abundant seeder and a perennial, it is hard to exterminate. It grows under the most unfavorable circumstances, and will replace grasses in meadows. Should it become too abundant, there is no way to destroy it excepting cultivation in some hoed crop until it disappears. The plants about roadsides, edges of fields and lawns, should be pulled by the roots, or kept from seeding by careful mowing. In this region it is abundant along the roadsides, and is increasing. Occasionally a field is noticed nearly overrun with it. Roadsides are prolific seed gardens that supply the public gratis with an abundance of seeds of the vilest weeds. The town authorities should be empowered by law to exterminate patches of weeds that appear, and might become the centres of distribution of troublesome pests. This weed will be found figured and described in Experiment Station Report, 1890, p. 120.

F. L. HARVEY,
Botanist for the Station.

ORONO.

ORANGE HAWKWEED.

Hieracium aurantiacum, Linn.

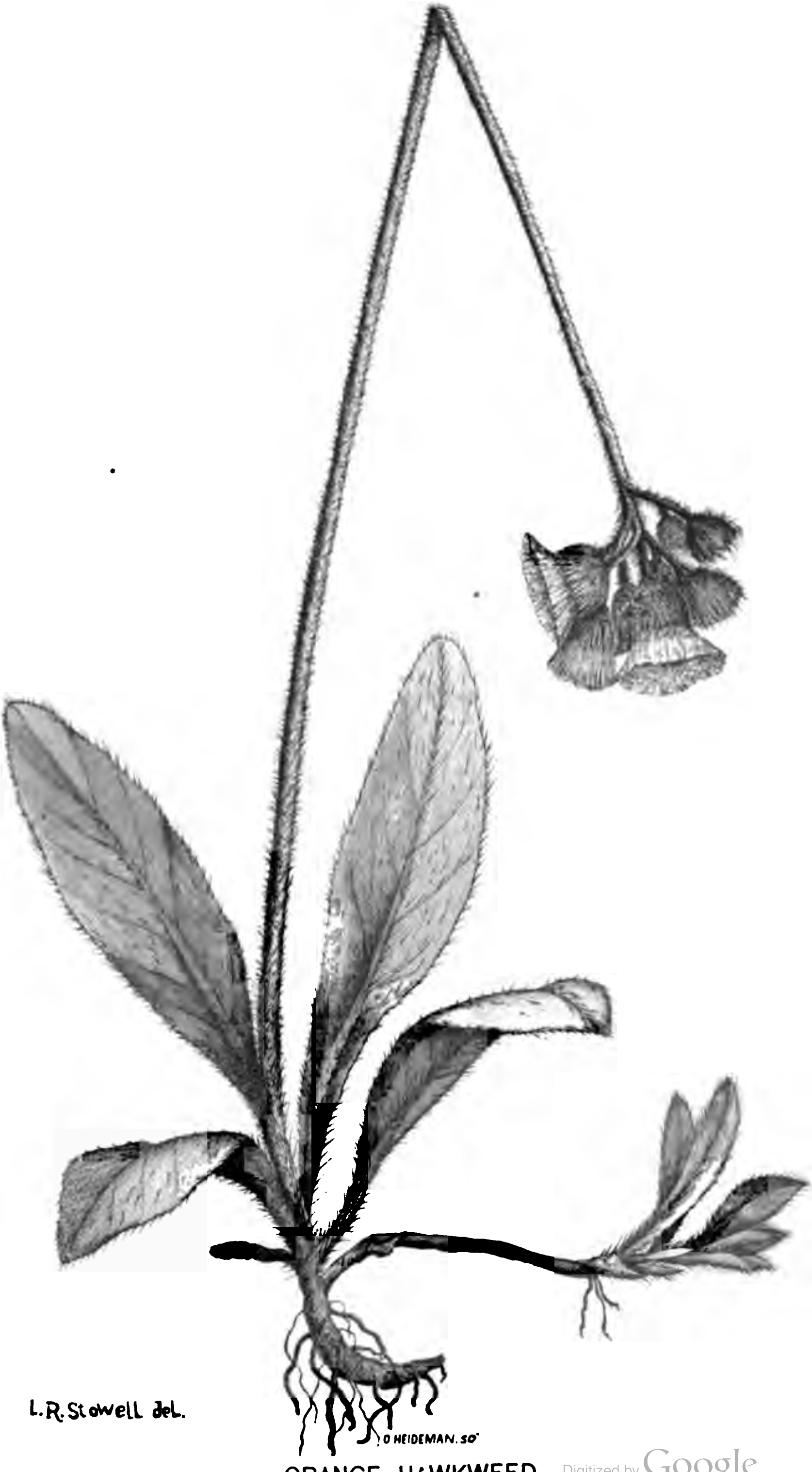
(Ord. Compositæ.)

The following letters were received the past season at the Station regarding the above plant. They show how rapidly the weed is spreading, and what a bad pest it is regarded by farmers. The plant has been found in limited quantities on the College farm in a pasture near the river, and has not spread very much in that place but the past season we noticed it in several places in the meadow land. Mr. James Walker of Bangor, reported a field of several acres near Pea Cove, nearly overrun with it. Mr. George W. Chamberlain reports it from Calais. These together with the localities given in the following letters show it is widely distributed in the State. The question so pointedly asked by Mr. Paine, whether "*we are at the mercy of our neighbors in the matter of spreading weeds*" is one that should seriously claim the attention of the legislature. There should be a law preventing farmers from harboring vile weeds in their fields or letting them grow at the roadsides on their premises. On property for which no one is especially responsible, the dangerous weeds should be eradicated at public expense. Why do not farmers urge some enactment for their protection? There should be a law subjecting seed sold in the State to inspection. The character of the seed sown is as important as the composition of the fertilizer used.

WINSLOW, ME., June 20, '92.

THE STATE AGRICULTURAL COLLEGE,
For the Prof. of Botany,
ORONO, ME.

DEAR SIR:—About two years ago I sent you, I think, a plant found in this vicinity which you identified as the Orange Hawkweed. It was not regarded as a dangerous weed at all. I wish to give my experience with it and ask if there is any way to compel farmers to stamp out such weeds under our law. I have fought it on this farm for about five years. It comes from a farm one-fourth miles square, two narrow farms intervening, and these farms are getting rapidly stocked with it. I have watched it with the greatest care and have picked it clean the middle to the last of June, and again scoured the fields after the haying and at frequent intervals till fall. In spite of the greatest care it is



ORANGE HAWKWEED
(*Hieracium aurantiacum*, Linn.)

gaining on me, and when these other farms are well covered I shall have to give it up. I am surrounded by the wild carrot, and have no difficulty in keeping it off the farm, but the Hawkweed, one of the vilest to the smell, seems almost impossible to eradicate. In my opinion, if its behavior indicates anything, it is the most dangerous weed that has threatened us, not excepting the Canada thistle. Will you be kind enough to inform me if we are at the mercy of our neighbors in the matter of spreading such weeds? A line from you will greatly oblige

Yours very respectfully,

G. S. PAINE.

EAST SANGERVILLE, ME., July 1, 1892.

BROTHER BALENTINE:

Find enclosed a plant (weed) that is rapidly encroaching into fields and pastures. It is known locally as *Missionary* weed. Its mission however is one not to be desired. The weed is described in the Report of the United States Department of Agriculture 1890 under the name Orange Hawkweed. This plant is rapidly spreading in the county from many different points. A recent trip in the town of Guilford and Foxcroft showed many fields completely overrun. The village streets and numerous grass flats in Foxcroft village are painted red with this weed. In fact it is a *monopoly* plant taking full possession of the soil, and destroying everything else. Do you know whether the weed is common in the State? It seems to me it cannot be, as I do not remember to have seen anything said of it in the Agricultural papers. Can you or any of your associates tell us how successfully to fight it? If you know aught of it, and methods of eradication please give them to me for publication in the Piscataquis Observer.

The rapidity with which this weed is taking possession of our fields is alarming to our farmers.

Truly, H. L. LELAND.

REMARKS.

This weed has recently been introduced into the Eastern United States from Europe. It has been in Maine on the College farm for at least ten years, and according to Mr. Paine, about Winslow for more than five years. We have no knowledge of the time or place of its introduction in the State. Such things are scarcely ever noticed until they do injury, when it is often too late or very troublesome to eradicate them. The experience of Maine farmers shows that the plant does not confine itself to roadsides and pastures, where the grass is short, but encroaches into meadows and overruns them. The plant being a perennial and developing runners and root-stocks, makes it a very difficult weed to control. Nothing short of destroying the roots will suffice. Besides, it is so hardy and tenacious of life that it takes almost complete possession of the soil. It is prolific of seeds, which are provided with a row of bristles (pappus), giving it the power of wide dissemination by the wind. We will be pleased to hear from anyone who has noticed this weed and to learn how long it has been known or anything regarding its introduction in the State. On the opposite page we give a cut of this weed and below a description, both copied without change from the United States Department of Agriculture, Report for 1890. They will enable anyone to recognize this vile weed.

"Perennial by slender root stocks and by runners; Stem simple, erect, one to one and one-half feet high, nearly leafless, densely hirsute, the hairs toward the apex of the stem black at the base; leaves mostly radical, oblong-lanceolate, denticulate, hirsute on both sides, sessile, those of the stems two or three; all but the lowest reduced to bracts; heads in a bracted cyme; peduncles with black, glandular hairs and a close brown coating of stellate hairs; involucre about one-third of an inch in diameter, its bracts linear-lanceolate, little imbricated, provided on the back with straight, glandular and stellate hairs; flowers all perfect, with ligulate orange-covered corollas; achenia about one line long, darkbrown, linear in outline, terete, ten-ribbed, truncate; pappus a row of dirty white bristles."

LEAF BLIGHT OF THE PEAR.

Entomosporium maculatum, Lev.

Attention has been called to the above fungus as doing damage to the leaves and fruit of pear trees in Maine.

The letters from Mr. Moore given below will indicate the nature of the inquiries. Mr. Moore's pear trees are located upon Diamond Island, Portland Harbor.

MAY 24, 1892.

HORTICULTURIST MAINE EXPERIMENT STATION.

DEAR SIR:—I enclose a few leaves from my Clapp's Favorite pear tree.

The leaves began to have this appearance two seasons ago, on one branch of the tree. Last year more branches were effected, and this year it seems to have spread over the whole tree. Is it Pear blight? and is there any remedy?

Yours Respectfully,

ARTHUR D. MOORE.

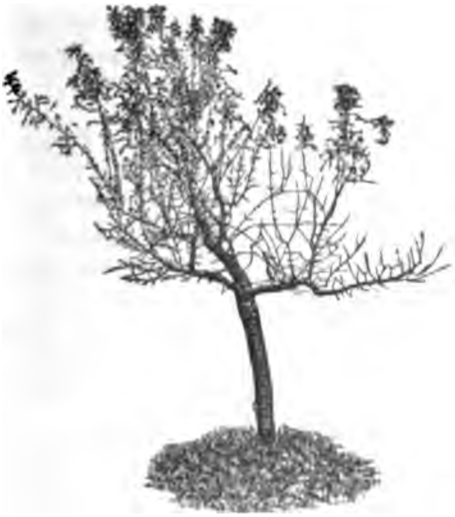


Fig. 1. *Tree not sprayed.*

The above letter shows how rapidly this disease spreads, and the necessity of applying remedial measures as soon as possible. We recommended the use of the ammoniated carbonate of copper solution, made as follows:

Dissolve three ounces of carbonate of copper in two quarts of commercial ammonia water (22°) and dilute with water to thirty-five gallons.

The first application should be made when the leaves are half grown and repeated according to the severity of the case every three or four weeks during the season.

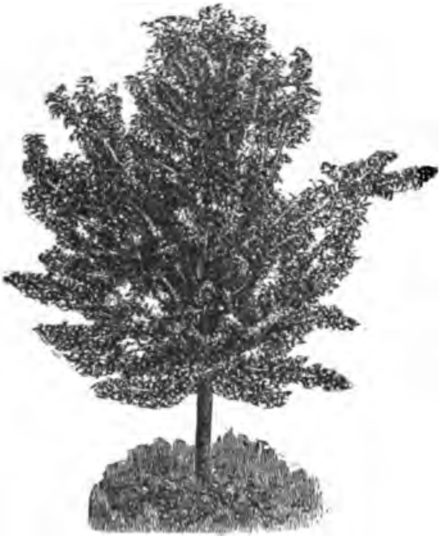


Fig. 2. *Showing beneficial effects of spraying.*

The experiments made by Mr. Chester of the Delaware Experiment Station, in 1891, show that the carbonate of copper and carbonate of ammonia solution is cheaper, as well as one of the most effective of the copper compounds used as fungicides. It is made as follows: Mix three ounces of carbonate of copper with one pound of pulverized carbonate of ammonia; dissolve in two quarts of hot water and dilute further with water to fifty gallons. Figures 1 and 2 show the relative condition of sprayed and unsprayed trees.

Mr. Moore made the following report:

Jan. 3, 1893.

PROF. F. L. HARVEY,

DEAR SIR:—Yours of the 27th at hand. I sprayed my pear trees with the ammonia and copper carbonate solution, according to directions as nearly as possible, June 13 and again July 16.

The fungus had already appeared when the first application was made, but it did not spread nor seem to kill the leaves as much as the year before. The leaves remained upon the trees this year until the usual time, whereas in '91 that part of the tree affected was entirely bare for a month before it should have been. I think the spraying has been of great benefit and will eventually cure the disease.

I thank you very much for your kindness to me, and for the interest you have taken in the matter. I also wish to thank you for the reports which you so kindly sent me. I have enjoyed them very much and have found much in them of value to me.

I will write you again in regard to the pear trees when the leaves appear next spring.

Yours respectfully,

ARTHUR D. MOORE.

P. S. The spraying seemed to stop the disease just where it was. In '91 it spread all over the leaf and seemed to burn it all up, so that they were all dead by the last of August.—A. D. M.

CHARACTERS OF THE FUNGUS.

This fungus causes a premature discoloration and dropping of the foliage and in some cases the spotting and cracking of the fruit. It has done considerable damage to pear and quince orchards. It does not seem to be as bad in Maine as in the Atlantic States farther South, but it is here and should be known and precautions taken to prevent its spread. Sometimes the leaves all drop early, but usually they drop slowly during the season. The leaves are unhealthy, the trees do not make a normal growth and sometimes a second blossoming occurs.

The disease first shows itself in the form of minute red spots, which increase in number and size and finally cause the leaf to shrivel and drop. The tender twigs are affected and often destroyed. The disease upon the fruit causes it to crack, through which germs enter and cause early decay.

BLACK OR HAIR MOLD.

Phycomyces nitens.

We received the above-named fungus from Mr. Martin, and as the species is quite common in Maine we give Mr. Martin's letter and an account of the plant.

FORT FAIRFIELD, ME., March 31, 1892.

FRIEND JORDAN,

DEAR SIR:—Enclosed with this letter you will find a piece of an elephant potato, to which is attached a hairy mane.

In the same hill there grew seven potatoes, all of which had a hirsute growth similar to the enclosed.

Will you please let me know whether this is the much-sought-for missing link, or what it may be?

This has elicited much curiosity and we would like to know of what nature it is.

Respectfully yours,

N. H. MARTIN.

The above-named mold belongs to an order of fungi known as *Mucorini* or *Black Molds*. The species of the genus *Mucor* are quite common on decaying organic matter and are frequently seen on rotten potatoes, squashes, pumpkins and other vegetables in the garden and in the cellar. They also are very annoying to housewives, appearing quickly upon bread, or cooked vegetables kept in warm, moist places. They may readily be known by their smoky black color, and the dense, erect coating of fine thread-like fibres with which they cover the substance attacked. These fibres bear at the ends small, round head like fruits, that are filled with small, oblong bodies called *spores*, capable of reproducing the mold. Where the fibres cross, spore-bearing bodies are also produced by a sexual process called conjugation. These spores have great vitality and will grow after they have been dried a long time. This accounts for their being everywhere. The spores are light and can be carried a long way by wind. A dry atmosphere is always prejudicial to their growth. The specimen sent by Mr. Martin is not a *Mucor*, but belongs to the genus *phycomyces* of the same *family*. It is quite common in Maine, but prefers oily instead of starchy substances to feed upon. We have frequently found it upon the excrement of cats, which was buried in dirt, or spent ashes out-of-doors, or more commonly in cellars that cats have access to, or under out-houses. The fibres of this plant are sometimes six or eight inches long and in dark cellars a beautiful, glossy black and wonderfully like hair in appearance. The specimens grown in more light, or in the laboratory, are less luxuriant and paler colored. The common species of *Mucor* are much smaller and shorter fibred. The spores of specimens kept in a dry laboratory for five years, germinated readily on bread in a moist chamber. This species of *phycomyces* showed streaming of cells contents (cyclosis) very nicely in a double current along the walls of the cells which joined at the end and flowed back down the centre.

The origin of the specimens sent by Mr. Martin was plainly the excrement of some animal that had been buried in the potato hill. The specimen submitted was growing on excrement, not on a piece of potato. If the potatoes of the hill were affected the fungus originated in the excrement and spread to them. This fungus is interesting, and is sure to attract attention, though it is not to be regarded as especially injurious.

ANTHRACNOSE OF THE RASPBERRY AND BLACKBERRY.

Glœosporium venetum, Speg.

Mr. Chas. S. Pope, of Manchester, Me., sent us the past season a bundle of raspberry canes badly infested with the above disease. He said: "My bushes are all dying with this disease.

They were obtained from a neighbor, who had them from Anderson, of N. Y. I find that my neighbor's are also dying with the same disease." Mr. H. H. Osgood, of Bluehill, reports the same disease as affecting his bushes of *Shaffer's Colossol* raspberry.

History. This disease was first considered by Prof. Burrell under the name "Raspberry Cane Rust," but it is now generally known as *Anthracnose*. It is a foreign species, but has become widely distributed in this country and does much damage to raspberries and blackberries.

Characters. It attacks the canes, leaves, petioles of the leaves, and in some cases the fruit. It attacks both the fruiting and non-fruiting canes. It first appears near the base of the canes as small, purplish spots. As the disease advances it encroaches upon the tops, and in the last stages will attack the petioles, leaves and fruit. The purplish spots enlarge and finally coalesce, producing irregular, light-colored, blister like patches, often over an inch long and sometimes encircling the stem, producing the same effects as girdling with a knife. The leaves and fruit are much dwarfed from a want of nourishment and finally the plants die. The disease lives over winter upon the young canes attacked and renews its ravages the next season.

The fungus producing these effects is a microscopic, internal, thread-like parasite, that creeps between the cells of the host plants, sapping their vitality. It does not usually enter the pith, but confines its ravages to the cells of the bark and cambium layer, causing them to shrivel and die. Near the centre of the diseased spots, where the ends of many of the capillary threads of the fungus meet and unite, are formed masses of short, club-shaped bodies called *basidia*. These are formed under the epidermis of the bark and finally burst it, appearing enveloped in a globule of gelatinous matter. Upon the ends of these basidia are borne singly, small, colorless, oblong, or oval celled bodies called *spores*. The spores are the reproductive elements and serve to spread the disease to adjoining plants and patches. The spores are held together in the gelatinous matter, which is soluble in water. The spores are liberated during rains and rapidly germinate in drops of water on the plants. Dry weather prevents the spread of the disease to new places, though the fungus will continue to grow in dry weather on canes where it is established. Spores liberated by rains are in a condition to be blown by the wind after the rainwater evaporates. Spores taken from specimens kept in the herbarium for several months will germinate, showing the vitality of this parasite, and warranting the belief that the fungus will live over winter in the canes.

PRECAUTIONS.

(*a.*) In the case of Mr. Pope's plants the disease was no doubt on the canes when planted and probably on his neighbors' bushes when they came from the nursery. We reiterate the importance of carefully examining nursery stock before planting it, to see whether it is affected by fungus or insect parasites. If found to be affected by a fungus it should be burned without delay.

(*b.*) As it seems quite certain that the spores of this disease survive the winter in old canes, those that are through bearing, or dead, or badly affected, should be removed at the close of each season and burned.

(*c.*) As moisture favors the growth of fungi the plants should be trained and framed so as to admit as free a circulation of air and light as possible. Planting in rows six feet apart and the plants five feet in the rows will admit plenty of light and air, and will admit of cultivation each way.

(*d.*) Spraying with a solution of sulphate of iron (green vitril) two pounds, to five gallons of water, before the buds start in the spring has been recommended.

(*e.*) Should the disease appear after the leaves are expanded the use of Bordeaux mixture is recommended.

REMARKS.

Those who wish to read a fuller account of this disease will find it considered in the Report of the U. S. Department of Agriculture, 1887, page 357, and illustrated on plate V.

THE POTATO BLIGHT.

Phytophthora infestans, De Bary.

To determine whether the germs of potato rot live over winter in the soil, or are planted in the seed, the following experiment was performed:

A quantity of rotten potatoes from a badly infested patch was gathered and buried in the ground under as natural conditions as possible. The next spring, two lots of seed that had shown no evidence of rotting in the cellar, were selected and planted as follows:

1. Two rows, one of each kind of seed, on the ground where potatoes rotted badly the past season.
2. Two rows one of each kind of seed upon land that had not grown potatoes for two seasons.
3. Two rows planted as in lot 2, but each hill infested with the rotten potatoes buried the fall before.

All the rows were fertilized alike with phosphates and ashes.

Results.

The disease did not appear in any of the rows.

This would indicate, so far as one experiment goes, that the germs do not survive the winter in the soil, and would emphasize the importance of selecting seed free from the rot. We are not satisfied with the results and will repeat the experiment.

Bordeaux Mixture for the Rot.

Mr. B. Walker McKeen has experimented with Bordeaux Mixture the past season, to prevent potato rot and we give below his interesting and suggestive report.

AUGUSTA, Dec. 31st, 1892.

DEAR PROF. HARVEY:

In reply to your favor of yesterday, asking for my experience with the Bordeaux Mixture for potato blight, I will say, that I used the mixture quite thoroughly through the entire season, putting it on three times, but the results were not such as to warrant me in recommending it to farmers without another trial. I raised a very fine crop of potatoes, all of good size, and the rust did not affect them to any great extent. Still there were some other pieces quite near me that were not affected materially. Other pieces suffered quite badly. I am inclined to the belief, that a *liberal fertilization* of the ground for potatoes will tend to place them beyond the reach of the rust, and that in this way farmers may prevent its ravages, in a great measure. Still I am prepared to say that I shall *certainly* use the mixture another year, as I am not yet prepared to condemn it, as I certainly think my crop was increased by its use. I hope to be able to report more fully after another trial.

In addition to my own experience, I might say that I furnished a neighbor material enough to put upon a small part of his piece and that he used it but once, and he is willing to say that the tops where the mixture was used remained green much longer than those which had not been treated, the difference being so great that the neighbors in passing stopped to learn the cause; but the difference in the crop was not what he expected it would be, from the looks of the tops. He will use it largely next season.

Yours very truly,

B. WALKER McKEEN.

In reference to the plan of liberal fertilization suggested by Mr. McKeen, it is well to remember that a patch of potatoes may be destroyed by potato blight in *two* ways. The germs of the disease may be in the seed, or in the soil upon which the potatoes are planted. In either case the germs would soon enter the young plants, grow with them and finally destroy them. In the second case the soil and seed may be *entirely free* from germs and the crop almost reach maturity and then becomes infested by *summer spores* blown from an adjoining patch and rapidly destroyed.

It is a principle, equally applicable to plant and animal life, that healthy specimens (all other conditions being equal) are stronger and better able to resist the attack of diseases and parasites. It is also a good rule to fertilize highly and feed animals well for by so doing the profits are greater.

It must be also remembered that plants under cultivation and animals under domestication make a more rapid growth than in nature, and that their tissues are much softer, and when once attacked by a fungus or parasite they become an easier prey.

If the higher fertilization of potato land will hasten the maturity of the crop, and thus prevent infection from the poorly fertilized lands of a shiftless neighbor, it would be an advantage.

If the germs are already in the patch, high fertilization would make the plants more succulent and give the disease a better hold.

An overgrown patch would also fall an easier prey to summer spores should they reach it at the right time.

We believe it is better to adhere to the rule, that *adequate fertilization is always best* and prepare ourselves to fight the parasites that are sure to attack the soft tissues of cultivated plants. The planting of early varieties would be an advantage, providing our neighbors grow the later sorts.

Bordeaux Mixture cannot destroy the potato rot in plants where it is established. It can only prevent the disease *spreading* by destroying the summer spores.

In experimenting with Bordeaux Mixture some rows in the patch should be left unsprayed to serve as a check.

Bordeaux Mixture is a fungicide of great promise and we hope others will try it and report the results.

ENTOMOLOGY.

FALL CANKER-WORM.

Anisopteryx pometaria, Harris.

(Ord. Lepidoptera : Fam. Phalenidæ).

This insect is increasing rapidly in the State. We have spoken in previous reports about its increase in Penobscot County, but it is also increasing in other counties. Mr. Freeman Partridge writes that it has done great damage about Prospect in Waldo County. Mr. C. A. Arnold, Arnold, Me., says: "They are the curse of my young apple trees, doing more damage to them by destroying the leaves and blossoms than all other insects combined." The shade and orchard trees about Orono were badly infested the past season. The garden fences in some parts of Orono were literally covered with egg clusters. As the insects feed largely on the tall elms and other shade trees and forest trees, there is no hope of exterminating them by confining our remedial measures to the orchard. We must take steps to keep them out of shade trees or they will continue to breed there and transfer their depredations to the orchard.

Mr. Partridge says the Canker-worms have troubled him for three years, increasing each season. Though the spraying done did not kill the Canker-worms it did destroy the *Codlin Moths*. He says he did not find a bushel of apples affected by this insect in his whole orchard, while he has had them in abundance before. This would indicate that the time to spray for Codlin Moths was about the time the Canker-worms are grown. We suggested the use of a band around the tree to prevent the *wingless females* ascending to lay their eggs. Mr. Partridge writes: "There is a bug nearly as big as a house fly that is crawling on the trees. I send you two. The little wingless bugs are lively on the south side of the trees though the snow is three or four inches deep among the trees." The insects spoken of above were the wingless females of the Canker-worm.

REMEDIES.

We would advise a trial of a tin band, which consists essentially of a band or circle of tin a few inches outside of the trunk of the tree, held there by a circle of muslin attached to the tin at its edge and drawn with a cord at the top, so as to fit the tree closely and prevent the insects from getting up without going over the tin. The tin is kept covered with a mixture of equal parts of castor oil and kerosene. As soon as they touch this they fall to the ground. The muslin can be fastened to the tin by turning over the edge of the tin before it is bent to a circle and inserting the edge of the muslin and hammering them together. The tin should be about three inches wide and long enough to stand out three or four inches from the tree, when bent around it and fastened by rivets. The whole inner surface of the tin is daubed with the mixture of castor oil and kerosene. The mixture should be renewed occasionally and the bands kept on the trees until the moths disappear. Fig. 3 shows the nature of the band and the way to attach it. Should the trees be full of eggs or young caterpillars then spraying would have to be resorted to.

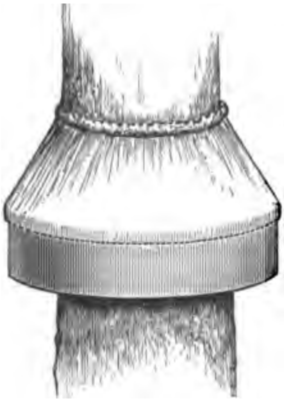


Fig. 3.

Mr. Partridge believes in thorough work and sprayed, using one-half pound Paris green to a barrel of water, consequently the leaves of Tallman Sweets were injured. He speaks of the flower buds of his trees being eaten, apparently before they open. This may have been done by the *Eye-Spotted Bud Moth;* see Sta. Rept. 1888, p. 169, also Rept. 1890, p. 128. The spraying should be done early enough to catch the young worms before they do much damage to the foliage. The time can be determined by watching a few clusters of eggs and when they are hatched the mixture should be applied, or to be safe two sprayings could be made, one just as the leaf buds are bursting and another a week later. While the leaves are young and tender we would advise a weak mixture, say one pound to two hundred gallons. It is a great shock to a tree to loose its foliage if it is not killed. The leaves are the food formers for the plant. They elaborate the food necessary to make the new wood and perfect the fruit, also it is their office to store, in the new wood and buds, the material necessary to form the leaves the next season. *It is important* to clear the trees of leaf-eating insects as early in the season as possible.

The reader will find an account of the habits of this insect in Expt. Sta. Repts. 1888, p. 166, and 1890, p. 137.

There is an insect closely related to the Fall Canker-worm known as the Spring Canker-worm. It differs principally in spending the winter in the ground, emerging very early in the spring and laying its eggs which soon hatch. The Fall Canker-worm changes to the moth state in the fall when the eggs are laid and do not hatch until spring. We have not noticed the Spring Canker-worm to any extent in Maine. We have at present to do with the more abundant one.

The females of both species are wingless, and as both feed on the foliage, spraying would be equally remedial for both. For the spring species bands would have to be applied in the spring. The bands on the trees in the spring would prevent the young caterpillars of both species climbing the trees.

THE BOLL-WORM OR CORN-WORM.

Heliothis armiger, Hübn.

(Ord. Lepidoptera: Family Noctuidæ).

Last September we received a package of sweet corn from Mr. John M. S. Hunter of Farmington, Me., and the following communication:

CHRONICLE OFFICE,
FARMINGTON, ME., Sept. 10, 1892.

SIR:—I send you by express to-day a box containing ears of sweet corn. A gentleman in this village planted the corn (sweet corn) in his garden. He tells me every hill is affected and corn in same condition as that which I send you. Will you please look it up and tell the readers of my paper what these worms are and how to exterminate them. This is a great sweet corn region and farmers fear these worms will give them trouble.

JOHN M. S. HUNTER, Editor.

About the same time we received specimens of the same insect from Mr. D. H. Knowlton, Farmington, Me., and learned from other sources that it was doing considerable damage to sweet corn in that vicinity.

The ears of corn received, each contained from one to half a dozen worms, snugly concealed beneath the husks at the top of the ears, that were feeding on the kernels. In some of the ears the kernels had been eaten nearly clean on the upper third of the cob. In some of the ears the worms had eaten most of the silk, and in others holes were gnawed through the husks at various places. We at once recognized the worms as the larvæ of the Cotton Boll-worm, an insect that has done untold damage to cotton, corn and various other crops in the West and South. This insect has done more damage in the Southern and Middle States than in the extreme Northern, but judging from the specimens received, it finds congenial conditions in the sweet corn fields of Maine. There is reason for serious concern regarding it, for if it maintains itself and increases, it will jeopardize the corn packing industry.

The damage done is not confined to the kernels eaten. The sap exudes from the kernels gnawed and ferments, so that it would be impossible to use the affected ears for canning. The exuded sap invites a host of smaller insects and fungi to share in the spoils. The husks being left open by the worms eating the silks, allows rains and dew to enter and favor the growth of moulds.

It would not pay to examine carefully each ear to see whether it harbored worms, small insects or fungi before cutting it for canning. Practically a crop much infested by this insect would be worthless for canning, and would have to be utilized so far as possible as food for stock.

If the insect confined its ravages to corn alone it might have a hard time to perpetuate itself on account of the sweet corn being gathered before the worms have their growth. Some of the worms in the corn sent were not more than one-third grown, others were half grown and only a few mature. We put them in a breeding cage and the smaller ones lived until December and died without entering the pupa state, while the larger ones remained gnawing the ears for several weeks before entering the ground.

We are inclined to think the larvæ may in some cases hybernate. The insect is quite a general feeder having been known to do much damage to peas, beans, pumpkins, tomatoes and tobacco, and probably has still other food resources. It should be careully watched for the next two seasons, and if it shows a tendency to increase and spread, concerted action should be taken to exterminate it. That the insect may be known when seen, we give below a condensed description of it in the various stages of its life history and also cuts of the eggs, larva, pupa and moths.

DESCRIPTION.

Eggs—nearly globular, a little flattened at the base, with a slight depression at the top and a series of depressions running from this depression to the base; diameter .025 inches; color pale straw. The moths are said to be capable of laying five hundred eggs which are placed singly upon the leaves by the first brood, and upon the silks and husks at the top of the ear by the later brood. The time required to hatch is supposed to be from two days to a week. Two views of the eggs magnified are shown in Fig. 4, a and b.

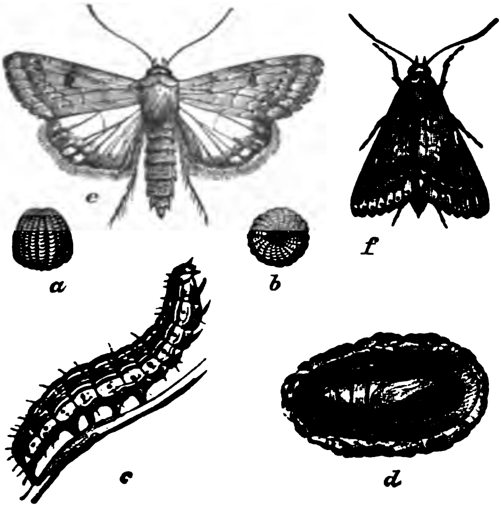


Fig. 4.

Larva—length 1.5 inches when full-grown; color variable, some being pale brown, striped with darker brown, others pale green striped with darker green. There is a dorsal brown band bordered by a narrow light line followed by a darker band that reaches to just above the breathing pores (stigmata) while the stigmata are in a light area that extends to the ventral surface which is of the general body color. On each segment are eight shiny black spots from which arise brown hairs. The four black spots on the back of each segment are arranged in the form of a trapezoid, with the parallel sides transverse with the body, the shortest side toward the head. The two black spots on the sides are just above the stigmata, one above and in front, the other back and on a line with them. Head and legs brown, shield on the neck (cervex) dark brown. A few short hairs scattered over other parts of the body. See Fig. 4, c. When full grown the worm enters the ground, forms a cocoon of earth interwoven with silk and changes to the chrysalis.

Chrysalis—length .8 of an inch. Color light chestnut brown, the dorsal line, stigmata and divisions of the segments darker. Rather slender, an indentation on the back where the abdominal segments begin, the last four segments moveable, two thorns at the extremity. See Fig. 4, d, which shows the chrysalis in the cocoon.

Moth—expanse of wings 1.5 inches. The color is quite variable in depth of shading. The more common color of the fore wings is pale clay yellow, with a faint greenish tint, and marked with darker olive, dark brown, or even black. A dark, conspicuous spot near the middle of each fore-wing. Hind wings paler with a dark brown band along the outer margin interrupted in the middle by a large pale spot.

The moth with expanded and closed wings is shown in Fig. 4, e and f.

LIFE HISTORY.

In Maine there is probably only one brood of the moths, at least we have no evidence bearing upon the subject to indicate more than one. The moths probably are on the wing early in August. (The larvæ we received on September 10th were of various sizes, some full grown, and though we have not taken the moths in Maine we know the larvæ require three or four weeks to mature, and the eggs several days to hatch which would require that the moth be on the wing early in August). The small worms found in the corn received were from eggs laid on the same ears later, requiring that the moths continue on the wing for some weeks or the time of emerging from the chrysalis extends over considerable time.

The moths mate and the females lay their eggs probably one in a place upon the food plant. They are on the wing early in the evening. The eggs are laid upon the leaves, tassels, silks or husks and hatch in a few days. The worms gnaw through the silk at the top of the ears and feed upon the kernels forming channels at the top of the ears. They will gnaw holes through the silk and go to other ears on the same stalk or even go to new hills. After feeding about three weeks or longer according to the season and the weather, they are mature and make their way to the ground choosing preferably a spot where the earth is compact, burrow beneath the surface making a round hole which widens toward the bottom and is slightly closed at the top. In this gallery they change to the pupa state. Where there is only one brood they hybernate in the pupa state and appear the following season and the round of life is complete.

REMEDIES.

Natural.—Bacterial diseases of the worm, moth and eggs are known, besides a half dozen or more insect parasites, Tachinas Ichneumons, prey upon them in the larval state. Lady birds, several species of hyemenopterous insects, tiger and ground beetles prey upon them, and chalcid egg parasites on the eggs. Bats and other insectiverous animals eat the moths. Insectiverous birds and barnyard fowls are fond of them and destroy both worms and moths. Ants and spiders destroy the eggs and young. It is also well known that they will eat each other.

Artificial.—In the extreme North where there is probably but one brood this insect would be more easily checked than where there are two or three broods in a season. Where there are several broods a few survivors of the winter would in the last brood become numerous.

The single brood of Maine could be managed by deep fall ploughing of corn lands to break up the burrows and expose the chrysalides to the effects of fall rain and winter freezing. If a field is found badly infested it would be better to feed the corn green to stock than to allow the worms to mature and enter the ground. Infested ears should never be left in the field so the worns can leave them and crawl into the ground. When possible crush the worms found with the hand.

Any one wishing to look up this insect farther will find a condensed article in the Fourth Report of the United States Entomological Commission, p. 355, which is finely illustrated with colored drawings of the worms and moths.

THE CHINCH BUG.

Blissus leucopterus, Say.

Ord. Hemiptera: Subord. Heteroptera: Fam. Lygæidæ.

During the past season the following letters were received:

SCARBORO, Aug. 23rd, 1892.

PROF. BALENTINE:

MY DEAR SIR:—I sent you a small lot of insects from North Fryeburg, on Aug. 8th. I did not know how badly they were destroying the grass, but find they have spread over a large part of the town of Fryeburg, and that the farmers are at complete loss to know what to do to stop their spread. Any advice you can give them would be very thankfully received. I saw Brother B. W. McKeen on Saturday last, and told him what I had done. He was not aware that the damage was so great, as the bugs had not got to his section. Nathaniel Frye, Fryeburg Centre, John Batchelder, or John Hastings, North Fryeburg, would probably give you any information asked for.

Yours respectfully,

W. B. NUTTER.

SCARBORO, Maine.

PROF. F. L. HARVEY,
ORONO.

MY DEAR SIR:—Your very kind letter of the 24th at hand, and contents noted. The bugs you speak of were collected in a field in my own town. They have been found there in years past, and have done considerable damage at times. Can you give me their origin, habits and remedy, if there is any? They work in the grass roots, particularly Timothy hay, which they completely destroy. Thanking you for your information, I am

Yours very truly,

B. WALKER MCKEEN.

We answered Mr. Nutter's letter informing him that the specimens sent were immature forms of the Chinch-bug. We also wrote Mr. McKeen and asked him to secure for us some mature specimens of the insect so as to make its indentification positive, and the following letters were received in answer:

SCARBORO, Aug. 29, 1892.

PROF. F. L. HARVEY:

MY DEAR SIR:—Yours of August 26th at hand. In explanation of my sending the bugs to Prof. Balentine, will say I was on a business trip to Fryeburg and seeing the damage the bugs were doing I thought it the quickest way to find out what they were and what to do to destroy them, to send to headquarters. I did not know of anyone except Prof. Balentine to apply to. I have written B. Walker McKeen in regard to the matter and hope you will be invited to make a visit to North Fryeburg and make an investigation. I feel that the matter is quite serious and demands the attention of the State officials to keep it within bounds and to stamp it out if possible.

I have written to Simeon Charles at North Fryeburg to send you some of the bugs in alcohol, and have also written to Nathaniel Frye at Fryeburg Center, asking them both to give you any information they can in regard to the time of the first appearance of the pests, and also how extensive they have become.

Yours truly,

W. B. NUTTER.

SCARBORO, Maine.

PROF. F. L. HARVEY:

MY DEAR SIR:—Your letter received, and I have sent to Mr. S. C. Charles, North Fryeburg, for further samples. Think he has some of the full grown ones in alcohol. I find some of our Fryeburg farmers claim the bugs have been seen here occasionally for many years, twenty-five or thirty, at least.

B. WALKER MCKEEN.

NORTH FRYEBURG, Sept. 6, '92.

PROF. F. L. HARVEY:

DEAR SIR:—Brother Nutter wrote to me about those bugs that he sent you, saying you thought them to be the chinch-bug. I have got some in a vial which I shall send by this morning's mail. They have worked here for years. Friend Batchelder thinks they were here twenty-five years ago, but did but little damage. They are confined to the intervale wholly—have not been on the upland at all. They have not meddled with anything but herd grass and red top until this fall, when they got on the sweet corn; but have injured it but slightly. Hoping to hear from you and some remedy for the pest, I remain,

Yours truly,

SIMEON CHARLES.

AUGUSTA, Sept. 8th.

PROF. HARVEY:

MY DEAR SIR:—I forward you this letter from Brother Charles. Please acknowledge receipt. Make a *full* investigation. If you plan to go to Fryeburg let us know.

Yours very truly,
B. WALKER MCKEEN.

NORTH FRYEBURG, Sept. 8, '92.

BROTHER MCKEEN:

DEAR SIR:—Received your letter last night. I sent the bugs the 6th. They seem to be going in an easterly direction. I think from what I can learn they are on the Hobbs' intervale. Mrs. Hobbs' boy told me about his grass. No doubt they are at work on it. Hoping to find some remedy,

Yours truly,
SIMEON CHARLES.

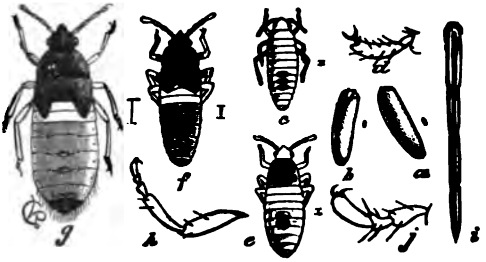
We were not able to visit the infested area without leaving class-room work at the college, and it was decided not to do so. Last fall we published a short article in the *Maine Farmer* announcing the occurrence of this insect in the State and suggested burning over the infested fields if possible. It will be desirable this season to learn the extent of the infested district, and we will be pleased to hear from all who may know of its occurrence even in small numbers upon their farms. That the insect may be known when seen, we give below a description of it in all the stages of its life history and suggest such remedies as have been tried in the West and South and have proved at all beneficial.

The information given below has been gleaned from the experiences of Riley, Forbes, Osborn, Gillette and others who have carefully studied the insect and remedies.

DESCRIPTION.

Eggs—Average length .03 in. elongate-oval, the diameter scarcely one-fifth the length. The top squarely docked and bearing four rounded tubercles near the center. Pale whitish and translucent when laid, but becoming amber colored with age, and finally the red parts of the enclosed embryo and the eyes show through. The eggs grow somewhat after being laid. See Fig. 5, a and b, which shows the eggs both natural size and magnified.

Fig. 5.



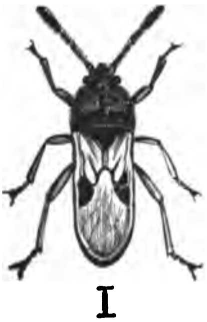
Chinch-bug, Larva, Pupa and Egg. *a* and *b*, eggs; *c*, young larva; *d*, tarsus of same; *e*, larva after first molt; *f*, larva after second molt; *g*, pupa; *h*, leg; *i*, beak or tubular mouth; *j*, tarsus of mature bug.

Larval stages.—The newly hatched larva (Fig. 5, *c*) is pale yellow, with simply an orange stain on the middle of three larger abdominal joints. The form scarcely differs from that of the mature bug, being but slightly more elongate; but the tarsi have but two joints (Fig. 5, *d*) and the head is relatively broader and more rounded, while the joints of the body are subequal, the prothoracic joint being but slightly longer than any of the rest. The red color soon pervades the whole body, except the first two abdominal joints, which remain yellowish, and the members, which remain pale. After the first molt (Fig. 5, *e*) the red is quite bright vermilion, contrasting strongly with the pale band across the middle of the body, the prothoracic joint [first behind the head] is relatively longer, and the metathoracic joint [third behind the head] shorter. The head and prothorax are dusky and coriaceous and two broad marks on the mesothorax [second joint behind the head], two smaller ones on the metathorax, two on the fourth and fifth abdominal sutures, and one at the tip of the abdomen are generally visible, but sometimes obsolete; the third and fourth joints of the antennæ are dusky, but the legs are still pale. After the second molt [Fig. 5, *f*] the head and thorax are quite dusky and the abdomen duller red, but the pale transverse band is still distinct; the wing-pads become apparent, the members are more dusky, there is a dark red shade on the fourth and fifth abdominal joints, and ventrally a distinct circular, dusky spot covering the last three joints.

Pupa—[Fig. 5, 6]. In the pupa all the coriaceous parts are brown-black, the wing-pads extend almost across the two pale abdominal joints, which are now more dingy, while the general color of the abdomen is dingy gray; the body above is slightly pubescent, the members are colored as in the mature bug, the three-jointed tarsus is foreshadowed, and the dark, horny spots at the tip of the abdomen, both above and below, are larger.

Perfect Insect (Say's description).—Blackish, hemelytra white with a black spot. Body long, blackish, with numerous hairs; antennæ, rather short, hairs; second joint yellowish, longer than the third, ultimate joint longer than the second, thickest; thorax tinged with cinerous before, with the basal edge piceous; hemelytra (elytra) white, with a blackish oval spot on the lateral middle; rostrum and feet honey-yellow; thighs a little dilated; length less than three-twentieths of an inch.

Fig. 6.



Chinch-bug, The short line below shows natural length.

(Le Baron's description.)—Length 1 2-3 lines, or three-twentieths of an inch. Body black, clothed with a very fine, grayish down not distinctly visible to the naked eye; basal joint of the antennæ honey-yellow, second joint the same, tipped with black, third and fourth joints black; beak brown; wings and wing-cases white; the latter are black at their insertion, and have near the middle two short, irregular black lines, and a conspicuous black marginal spot; legs dark honey-yellow, terminal joint of the feet and the claws black.

LIFE HISTORY.

The *mature bugs* hybernate and may be found during the winter months under grass, dead leaves and rubbish, in the field and about thickets and timber adjoining the infested area. When the weather is warm enough in the spring they emerge from their hiding places and after finding suitable food plants for their young deposit their eggs. This probably occurs in May in Maine, but we have not had opportunity to determine when they begin to move. Each female is said to be capable of laying about five hundred eggs, and oviposition extends over twenty days. After the eggs are laid the bugs live some time and may do damage before they die. The eggs hatch in due time and the young pass through the larval stages described above and finally pass into the pupa stage. Bugs hatched in May become mature in July when after pairing eggs for a second brood are laid. In July there is usually a flight of the bugs to new fields and by this means the infested area may be greatly extended. The second brood reaches maturity in the fall and by cold weather is ready to seek winter quarters, completing the life history.

REMEDIES.

It is well known in the West and South where the Chinch-bug has done so much damage, that there are Chich-bug years, when climatic conditions combine to favor the rapid increase of this pest. A wet, backward spring and well distributed summer rains are known to destroy the eggs and young of the first brood and prevent the great increase of the second brood later in the season. The correspondence given above shows, that the pest has been in Maine in the infested district for a great many years, and it has not done serious damage until the past season. The conditions last year were probably a dry time while the eggs and young of the first brood were maturing and they survived in greater numbers than usual and gave rise to a much larger second brood. The coming season may be unfavorable for them and no great injury occur. The heavy rain fall of Maine will probably protect this State from such severe scourges as some of the Western States with less rain fall have suffered. The Chinch-bug seems very much adverse to fresh water baths and does not flourish in moist climates, upon very wet lands, or upon luxuriant crops that shade the ground and keep it moist.

The correspondence shows that the area is increasing and the matter is serious enough to demand careful attention. There should be concerted action upon the part of the farmers of the infested district. Whatever remedy is adopted to check this injurious insect will be of little avail unless it is a combined effect of the entire population in the infested district. One of the great difficulties is to secure concert of action. There are improvident farmers in every neighborhood who harbor weeds and injurious insects and will not destroy them, and there is no law to compel them. Public opinion and moral suasion are the only available levers. Below we suggest some remedial measures that may be applicable in Maine.

a, *Clean Culture.*—As the Chinch-bug hybernates under rubbish, etc., and those that survive the winter determine the number to lay eggs the following season; hence all rubbish and other material about the fields under which they can find shelter should be removed.

b, *Ploughing.*—When a grain field is badly infested it should be ploughed deep immediately after harvest before the bugs can migrate to adjoining crops. The land should be ploughed at least six inches deep and turned as nearly upside-down as possible. By this means a great many young bugs will be destroyed. We do not know whether the bugs have attacked grain fields in western Maine. This remedy would be applicable to a meadow as well as grain field if there was no objection to breaking it up. It is well to harrow and roll the land after ploughing to harden the surface and make it more difficult for the bugs to crawl out. If the bugs are found very numerous along the border of a meadow or in small patches in the field it would be well to plough these places early in the season and in two or three weeks sow to a late crop. Fall plowing is advisable, and if rubbish, straw, manure, etc., are placed on the field the bugs will crawl under it for shelter and be ploughed under. In plowing the use of a jointer is advised as it causes the surface of the ground to be more thoroughly buried.

c, *Burning.*—When the grass or grain stubble is dense enough or dry enough, the entire field should be burned over after harvest. If the bugs are found in a meadow in the fall, that you wish for grass the following season, and the stubble will not burn, then wind-rows of straw or swamp-hay should be put across the field. The bugs will seek shelter under them, when they should be burned early in the morning or late in the evening. The burning should be carried to all other places where they are known to be hybernating.

d, *Miscellaneous Remedies.*—*Early planting* and *heavy sowing* and good *fertilization* have been found important aids in the West to hold this pest in check. The Chinch-bugs only feed upon members of the grass family and rotation of grain with buckwheat clover, peas, beans, or other root crops would starve them out. In the West they sow strips of millet, of which the bugs are very fond, and after they gather upon it it is cut and the ground immediately plowed deep and rolled. Various insecticides have been used with more or less success, but they are omitted as perhaps of no application to checking the insect in Maine.

Maine State College Experiment Station.

PLATE II.

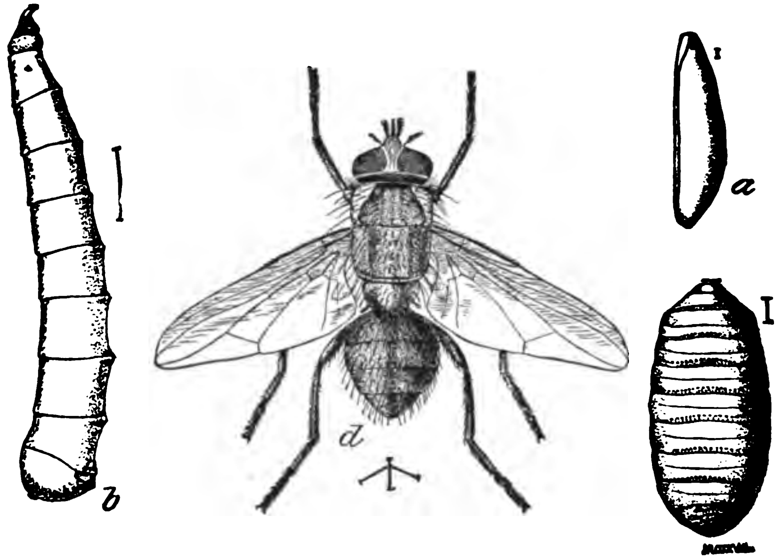


Fig. 1.

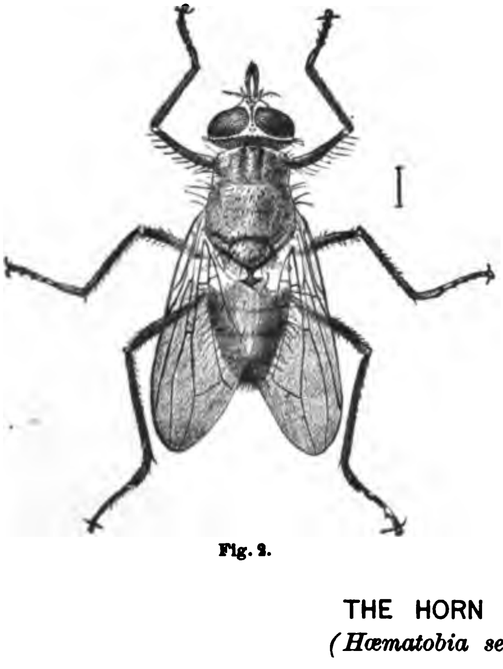


Fig. 2.

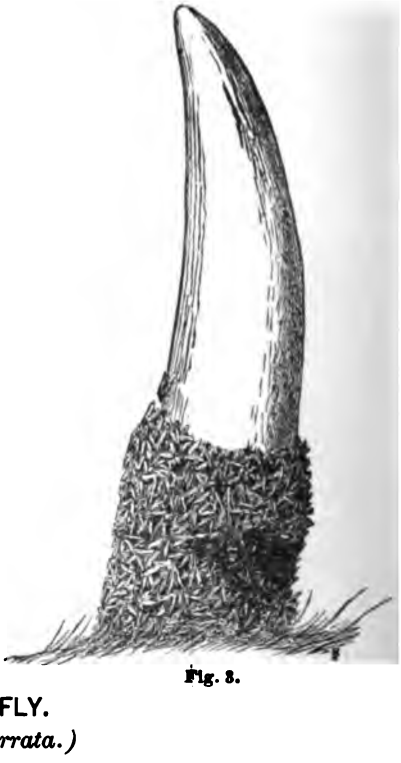


Fig. 3.

THE HORN FLY.

(*Hœmatobia serrata.*)

Fig. 1. *a* Egg; *b* Larva; *c* Puparium; *d* Adult in biting position—enlarged. Fig. 2. Adult in resting position—enlarged. Fig. 3. Flies in resting position at the base of the horn—reduced.

THE HORN FLY.

(Hœmatobia Serrata, Robineau Desvoidy.)

Ord. Diptera: Fam. Muscidæ.

We received the following letters regarding the occurrence of the Horn Fly in Western Maine:

AUGUSTA, Aug. 27, '92.

PROF. HARVEY:

MY DEAR SIR:—The Buffalo Horn Fly has been very troublesome in Fryeburg and vicinity, so much so that I have used Kerosene Emulsion (Weed formula) on our cows to protect them from their very sharp bites.

Yours very truly,

B. WALKER MCKEEN.

NORTH FRYEBURG, Sept. 6, '92.

PROF. HARVEY:

DEAR SIR:—We are having a visitation of the *Horn Fly*. Can you give us any information in regard to them? They do not appear to bite the cattle very much and do not annoy the horses at all, but they come in immense numbers and over a large territory at once.

Yours truly,

SIMEON CHARLES.

REMARKS.

This is a European species first noticed in this country in 1887, in the vicinity of Philadelphia. From that point it was spread both to the north and south but more rapidly southward, and now occurs from Canada to the Gulf, west to the prairie states and Texas. The first report of its occurance in Maine was September, 1882, in the vicinity of North Fryeburg, Western Maine. We have not observed it in the Penobscot Valley.

Below we give a condensed account of the life history and such remedies as have been suggested. Those who wish to study the insect more in detail will find it considered in Insect Life, Vol. 4, No. 2, Washington Government Printing Office, 1892, and in U. S. Agrl. Rept., 1889, page 345.

The flies resemble the house-fly in general appearance but are only about half as large. While feeding the wings are spread at an angle of about 60° (see Fig. d) and elevated.

LIFE HISTORY.

The reddish brown oval eggs Fig. a. are laid during the warmer parts of the day, singly and usually upon their sides upon the surface of the dung immediately after it is voided, the time of oviposition occupying about a minute. The eggs hatch and the larvae (Fig. 1 b.) descend intothe dung, remaining near the surface. When ready to transform the larvæ descend to the ground beneath the dung and enter it from a half to three-quarter of an inch, or if hard probably transform on the surface to the puparium. (Fig. 1 e.) In from ten to seventeen days from the time the eggs are laid the flies appear. (Fig. 1, d.) There are probably seven or eight generations annually in the middle or southern latitudes, but probably a less number in Maine. The fly makes its appearance in May or June and becomes most abundant in July and August, dwindling as cold weather approaches. It probably hybernates in the pupa and adult stages. The flies, when abundant and especially early in the season, collect about the base of the horns of animals to rest, hence the name.

DAMAGES.

The milk of milch cows is reduced in quantity and animals for the shambles rapidly loose flesh. The irritation due to the bites causes the animals to rub themselves, producing sores. The flies bite the animals and suck the blood.

REMEDIES.

Protective Applications.—Almost any greasy substance wil keep the flies off for several days. Train oil or fish oil alone, or with a little sulphur or carbolic acid will keep the flies off for several days. Tallow has been used to good advantage. Common axle grease will answer nearly as well. These should be applied on the parts of the body most frequented.

Applications to destroy the fly.—A spray of kerosene emulsion directed upon a cow would kill all the flies it happened to touch. Dusting the cows with pyrethrum or some other dust insecticide, as tobacco, is recommended.

Applications of insecticides intended to check the pest by destroying the flies are hopeless against the immense swarms of them.

How to destroy the early stager.—Thoroughly lime the dung or spread it so it will dry. This will destroy large numbers of the larvæ. The most of the dung is dropped in places where the cattle collect after feeding, or at night and could be treated without much trouble.

THE TWO-SPOTTED MITE.

(*Tetranychus 2-maculatus*, *n. sp.*)

Ord. Acarina: Fam. Tetranychidæ.

We first noticed this species in Orono, Me., early in the spring of 1891, upon rose bushes exposed in a window at the Post Office. Since then it has spread to most of the plants in the window excepting geraniums, for which it seems to have an aversion. Mr. White whose rose bushes were infected thought the mites got on while his plant was loaned to a sick lady, but on inquiring we found no other plants were in the sick room at the time and the only possible source of infection was cut plants, which was improbable. In order to learn how general the distribution of this mite was in this region, we visited several houses in Orono, where house plants are kept, and in the majority of places found the mites doing considerable damage. Rejecting the positive statement of one party that these mites are the same as lice on hens and that her plants were all right until she set them out of doors and some lousy fowls infested them, we are inclined to think that the pest was introduced in Maine upon rose bushes and other plants purchased of a prominent dealer. The parties whose plants are infested in most cases had plants from this house and one party positively affirmed that the roses received were noticed to be infested when unpacked. Though great vigilance ought to be exercised by dealers that the plants they send out are in good health and not infested with injurious insects and fungi, yet they cannot always be held responsible, especially when the parasite is small and readily overlooked. Those who receive infested plants will have to discard them, or fight the pest by aid of known remedies.

Even experience has been no protection against the introduction of this mite for it has found its way into the large green houses of the country, also in the green house at the college in our own State and has been a source of much annoyance.

The mite is so small it is next to impossible to examine greenhouse stock or house plants carefully enough to prevent its introduction, and the custom of exchanging slips of plants for culture, so common in every neighborhood, aids greatly in its rapid dissemination.

The mite being firmly established in Orono and no doubt in many other places in the State, and having given so much trouble at various green-houses in the country and apparently never having been studied, described or figured by any of our entomologists; information regarding its life history, structure and control would seem to be of enough importance to warrant a careful study of the pest.

Having spent some time during the past two years investigating the nature of this species, the following preliminary notes upon it are humbly submitted, with the hope that they may aid in recognizing the form and put our florists upon their guard against it. We cannot hope to have been infallable in our observations, but have tried faithfully to record what we have seen.

We desire to acknowledge our indebtedness to Prof. L. H. Bailey of Ithaca, N. Y. for specimens of this mite, and also of the red spider for comparison, for a list of host plants and other data from his experience with it; to the Dingee & Conard Co., West Grove, Pa., for specimens of red spider and notes; to Peter Henderson & Co. for specimens of the mite on *Verbena* and notes; to Prof. Munson and citizens of Orono who from their abundance have supplied us without reluctance with all the specimens used for study.

CORRESPONDENCE.

After discovering this mite at Orono, Prof. Munson suggested that it was probably the same species that had given so much trouble in the green-houses at Ithaca, N. Y. We wrote Prof. Bailey and sent him a description of the mite. He responded: "Your description seems to match the mighty mite which we have. I do not know its name. Prof. Comstock does not know it." We wrote again for specimens for comparison and a list of food plants and in our letter called the species *Tetranychus 2-maculatus*, n. sp., as we had not been able to find any published description of it. Prof. Bailey responded with specimens upon Pepino, which proved to be the species found at Orono, also he stated: "This is the 'Verbena mite,' I suppose, of Henderson's Practical Floriculture." We responded to Prof. Bailey that the specimens sent were the same as the species found here, but whether they were the same as the *Verbena mite* referred to in Henderson's Practical Floriculture could not be determined by the vague description given in that work, which though it might serve the purposes of practical horticulture, was valueless from an entomologist's standpoint.

PLATE III.

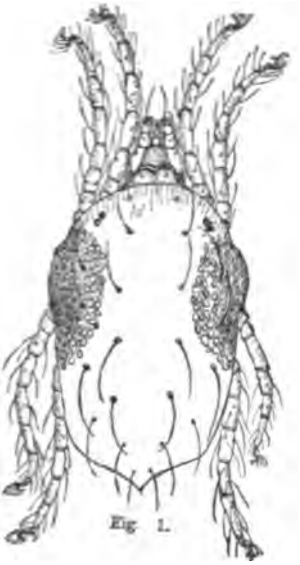


Fig. 1.

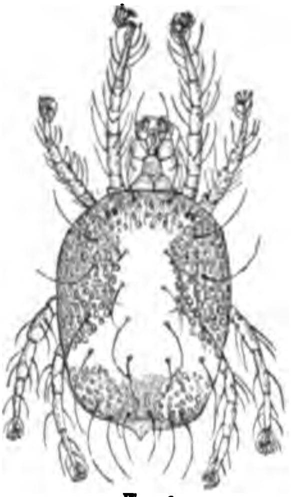


Fig. 2.

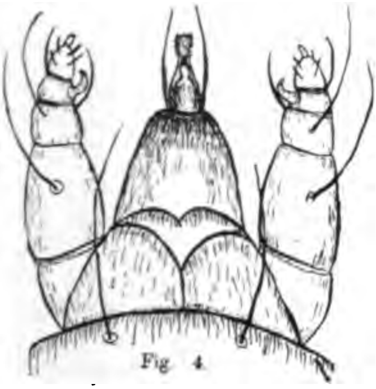


Fig. 4.

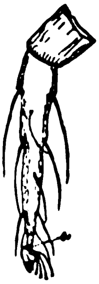


Fig. 3.

F. L. HARVEY, Del.

TWO SPOTTED MITE.

(Tetranychus 2-maculatus, n. sp.)

Fig. 1. **Male mite magnified 100 times.** Fig. 2, Female (probably) magnified 100 times. Fig. 3. Foot much magnified *(a)* showing location of moveable joint. Fig. 4. Mouth parts and palpi magnified about 250 times.

If you have seen what Henderson calls the "*Verbena mite*" and know it to be the same species as you sent me, that certainly is a clincher. Henderson's figure certainly is nothing like the mite in question. His figure is pointed in front while the mite we are considering is broadly oblong and rounded in front. Henderson's figure is 20 m m. (.8 in.) in length and he says it is magnified four hundred times. This would make the mite only .05 m m. (.002 in.), a *very minute microscopic form*. The mite we are considering is fully .5 m m. or .02 in. and *plainly* visible to the naked eye. Perhaps Henderson made a mistake and his drawing was only forty times magnified. We could believe this if he did not state that the *Verbena mite* "is so small that it cannot be seen by the naked eye." Henderson says it has the power of imbedding itself in the leaf, a habit which *certainly* does not apply to the species in question. Certainly Henderson has made a good many mistakes in his description or the species he examined was a different species. We believe it is best for entomologists to entirely ignore such loose, vague descriptions of insects as they are of no technical importance and only add confusion in defining species.

In the absence of any known technical description of this species, we concluded it would be better to describe it under the name *Tetranychus 2-maculatus*, n. sp., and have something *definite* than to leave the form without a name. Should it subsequently be shown that it has been described then our name drops and no harm is done. We will be most grateful for any evidence that this species has been described or named for we have no ambition to multiply synonyms.

Prof. Bailey responded: "I am aware that neither Henderson's description nor figures are applicable to the mite in question, and yet I think that he meant it, for I have known for some time that he has been troubled with the same species we have. Of course the reference, even if proved to apply to the mite, is of no scientific use, and I only referred you to it that you might perhaps gain a wider knowledge of its hosts and distribution. No doubt Alfred Henderson could send you specimens for determination."

Prof. Bailey kindly introduced us to Mr. Henderson and we requested specimens of the *Verbena mite* which proved to be the *same* species found at Ithaca and Orono.

Parties about Orono having stated *positively* that roses obtained from Dingee & Conard Co., West Grove, Pa., were infested by this mite, and we having seen the mite on rose bushes from that firm at one house and not on *any other* plants, and the mite having been first noticed at the Post Office in Orono on roses, we wrote Dingee & Conard Co. about the matter and below we give their reply.

WEST GROVE, PA., Jan. 21, '92.

FRANCIS L. HARVEY, ESQ.,
Orono, Me.

DEAR SIR:—Your kind letter to hand and contents carefully noted. We will gladly give you any information we can to assist you in this important undertaking. The insect or pest you describe which is so seriously affecting window and house plants through your locality, we must say we know nothing of. We have not come in contact with such a pest in any of our houses or on our plants like this, and can assure you it did not originate with us, or we would know something of it. Such pests are more frequently found among soft wooded plants. We have but little of this class of stock in our establishment and consequently are troubled but little with any insect. We are sometimes visited with the *red spider* on our roses, but such is a very rare occurrence, and when thus affected it is not at all a serious matter to get rid of them, syringing them twice a day being a very satisfactory remedy and always effective. We find when plants are kept in a perfectly healthy condition there is little or no danger of the pest or insect of any kind attacking them. The *red spider* can hardly be termed a pest. It is with us but a mild disease caused by too warm and dry an atmosphere. We shall be glad if this information is of any advantage to you and will gladly give you any other information we can.

Very truly yours,
THE DINGEE & CONARD CO.

We wrote again to Dingee & Conard Co. for specimens of what they regarded as the *red spider*, and the species sent was the same as the one found here so far as we could tell from a careful microscopic examination. We also requested Prof. Bailey to send us specimens of the *red spider*. He said they had none in their houses but one of his men procurred some from another source which we were unable to separate from the Cornell green-house specimens only by their being redder in color.

We must confess that we are very much confused by the above data. Henderson, Bailey and Munson, who have had considerable experience with this mite are decided in their opinion that it is entirely different in its habits from the *red spider* and will not yield to the same treatment. If the specimens sent us by Dingee & Conard Co. and Prof. Bailey's men, were the genuine *red spider*, we are forced to conclude that in this mite we have a species scarcely separable from the *red spider* by its structure but differing very much from it in habit. If called upon to decide from the structure alone we would be compelled to call it a form of the polymorphous species *Tetranychns telarius*, L., or *red spider*.

No importance can be attached to color in this species nor in the *red spider* for in both it is variable with the food plant and also with the age, each molt disclosing a different shade. All we have left upon which to construct this species is the marked physiological differences, noted by Henderson, Bailey and Munson. Can it be possible that it is a case of adaptability—a form of the *red spider* that has changed its mode of living to suit new conditions? Such cases are not uncommon among insects. We leave it an open question for a want of sufficient data. The published descriptions and figures of the *red spider* are so meagre and so lacking in minute detail that it would be very difficult to determine from them whether specimens in hand belonged to that species. Even the published characters of the genus Tetranychus are faulty on account of imperfect microscopical examination.

GENERAL DESCRIPTION.

Perfect insect—length of full grown specimens, including palpus, .4 to .6 m m.; breadth, .25 to .3 m m.; thickness .175 to .2 m m. Broadly oval, about two thirds as broad as long. Broadest in the anterior third of the body back of the eyes, where the sides are somewhat swollen. General color when young or free from food, pale orange or greenish yellow, becoming yellowish orange or orange with age. The *majority* of the specimens have a dark spot on each side as shown in Fig 1. due to food contents. These spots first appear, in young specimens which have six legs, as scattered brownish or greenish spherical bodies that look like oil drops. These increase in number with age and are sometimes arranged in three groups. Finally they merge into a single mass as shown in Fig. 1. In older specimens dark patches are found in the anterior and posterior portions of the body, (see Fig. 2), or in full fed specimens the body is entirely dark colored. The shade seems to vary with the color of the food, from the yellow orange and brown to green, dark green or black; those feeding on calla, especially, a deep dark green.

The palpi and legs, especially in older specimens, are tinged with orange. The young are smaller, paler and have only six legs. Body and legs clothed with stout bowed hairs. There are four rows of about five hairs each on the dorsal aspect of the body. Eyes carmine, composed of two facets placed one ahead of the other, and obscurely bilobed. Palpi about one-fourth the length of the body. Eggs spherical, diameter variable, length 75 to about 110 micromillimetres, glassy, scattered and loosely attached to the web. Web delicate, filmy, stretched loosely over the surface of the plant, principally on the under surface of the leaves, though sometimes the upper surface is covered, often stretching across from leaf to leaf, or from the stem to the petioles. They are more plentiful along the principal veins, especially where they join the petiole, also in the angle where the petioles join the leaf, being plainly visible to the naked eye and giving a glassy or silvery reflection from the surface covered. Fibers of the web are from 10 to 20 micromillimetres in diameter but apparently composed of smaller fibrils. The web does not seem to be geometrically constructed as that of the spider. The mites walk freely over the surface or secrete themselves beneath it. The feet are long and the movement of the mite slow and spider-like.

MICROSCOPIC CHARACTERS.

The body, legs and mouth parts magnified five hundred diameters appear finely corrugated, the ridges and furrows often less than .001 m m. wide. On the under side of the body toward the posterior end is an elevation in which the corrugations are much wider and zig-zag. This probably marks the location of the spinerets and anal opening. The stout hairs clothing the body are in full grown specimens often one-fourth the length of the body, or about .15 m m. The eye facets are about .05 m m. in diameter. The hairs on the legs are about four times as long as the legs are wide where they occur, or sometimes fully .1 m m. long. The legs are composed of seven joints exclusive of the moveable foot portion. The seventh joint is short, a little longer than the three segments of the foot combined and has but little movement with the sixth joint. The foot portion is composed of three joints, the proximal two about equal in size, same length but wider than long; terminal segment curved and ending in a two claws; each fork ending in a brush of about three stiff, pointed, spreading hairs. At the back on the end of the preceeding segment arise four stiff bowed hairs over .02 m m. long ending in hemispherical swellings which are broadest at the end and flat or slightly rounded. These hairs curve in the same direction as the claw and extend considerable distance beyond it. There is a free joint between the seventh segment of the leg and the foot portion. The two joints and the claw make up the moveable parts. When walking on glass or any smooth surface the mite puts the paw out behind as one would bend the hand backward at the wrist, resting on the end of the seventh joint, the claw and the end of the four stiff hairs, the terminations of which are put squarely down upon the surface. These hairs with enlarged ends may be used for spinning as suggested by Murray, but one cannot watch the movements of this mite without believing they are adapted for locomotion.

According to Murray, the stiff hairs on the feet of *Tetranychus telareus* (the *red spider*) are attached to the claws, and he has so represented them in a cut (Economic Entomology, p. 97). In this species they are appendages of the small joint of the foot next to the claws. Also he says these hairs have globular terminations and so figures them. In our specimens the hairs end in trumpet-mouth like terminations, disc-like at the ends and are put flat on the surface in locomotion. Prof. Riley in *T. 6—maculatus*, (U. S. Agrl. Report, 1889, p. 111), represents the hairs as originating from the back of the claws and as hooked at the ends. The mouth-parts of the *red spider* as shown by Murray, and those of *T. 6 maculatus*, Riley, differ from those of our species.

According to the characters laid down for the genus *Tetranychus* by Murray, there should be only seven joints in the legs. We are at a loss to know just what was included by him in the terminal or tarsal joint. There are seven segments in the leg above the moveable joint in the foot region spoken of above. If the three moveable elements below this joint constitute a distinct segment, then there are *eight* joints to the leg. If the fixed short segment above the moveable joint is concluded in the terminal segment, then there are only *seven* joints to the leg. The location of the joint is shown in Fig. 3, a. Extending from the front of the carapace are the mouth parts, made up of the palpi, rostrum or beak, proboscis and mandibles. The *palpi* (see Fig. 4) are seven jointed. The terminal joint is short, about .008 m. m., with parallel sides and an obtuse rounded end, twice as long as broad. Second joint is broadly conical, somewhat broader at the base than long, length about .015 m. m. at top and .025 m. m. at base, bearing on the inner face about four bristles, see Fig. 4. The third joint is not more than half as long as broad (about .015 m. m. by .03 m. m.) bearing on the inner side a claw about .02 m. m. long, curved toward the face of joint two, which bears the bristles. There is a free motion between segments two and three, and joints one and two are moveable and opposed to the claw on joint three, making nipping jaws. The structure of the end of the palpus of this species has a striking resemblance to that of *T. 6—maculatus*, Riley figured in U. S. Agrl. Report, 1889, pl. II., though the third short joint bearing a claw seems to be absent, or not shown in his drawing. The *rostrum* or *beak* is composed of three segments, (see Fig. 4) the basal one composed of two parts, broad at the base and rounded in front, and at the carapace reaching beyond and covering the base of the palpi. The second joint is short and emarginate in front, terminal segment tongue shaped, obtuse and emarginate in front. Originating beneath the rostrum and extending forward beneath the palpi are two stout hairs. The basal portion of the proboscis is covered by the beak of the carapace. The visible portion is composed of three joints. The basal is broadest and oblong; the terminal one slender, rounded in front and bearing at the edge two short spines and near the end numerous slender spines. The details of the mandibles we could not make out clearly but think they are rounded and plain on the outer margin, bearing at the end a lobe which projects beyond the end of the proboscis.

Greenish black spots are usually found on the leaves of plants affected by this mite. Probably this is the reason why Henderson called the disease by the inappropriate name "Black Rust." It is commonly believed that these dark spots are formed from juices of the plants that have exuded from punctures made by the mites and have dried. A careful microscopic examination proved them to be small usually globular masses from .1 m m. to .175 m m in diameter and composed of spherical elements from .025 to .035 m m. in diameter. These spherules are clear with granular contents, or greenish with a darker centre. A careful comparison of them with the contents of the body of the mites proved that they were excreta. These yellowish, or black balls are often found attached to the fibres of the web in *mid air* between the points of attachment of the web where it stretches across from leaf to leaf or from stem to leaf. This could not possibly occur if they were exudations from punctures. The web running over the surface and dotted here and there with these yellow and black excreta reminds one of aminute erysiphe in different stages of development.

HOST PLANTS.

From the table of host plants given below, it will be seen that this mite is a general feeder, attacking a wide range of both glabrous and hirsute plants belonging to a wide range of families. This list is no doubt far from complete, as no great pains has been taken to make it exhaustive. Should this mite prove capable of living out of doors it would become a double terror to horticulturists. It at present is found out of doors only in rare instances, and there is no evidence that it is as Henderson suggests, common in gardens, or the same as that which produces roughness to particular parts of cherry, plum and peach trees. Our experience does not warrant the belief that it attacks *especially* plants of lessened vitality. These mites, like plant lice, live by sucking the juice of plants, and are pretty good judges of proper feeding grounds. They are not likely to turn aside from a healthy juicy plant to one of the same species that is sickly and lacking in juices. They are small and would escape observation until a sickly condition was produced in the host plant and attention directed to it. We believe that instead of especially attacking sickly plants they are the cause of lessened vitality. The list of host plants given below shows that the mite has no special preference for pubescent plants, in fact, some of the worst cases of attack we have seen were upon glabrous species. Munson and Harvey are authority for the occurrence of the mite at the Maine State College green-houses and at private houses in Orono and vicinity; Prof. L. H. Bailey for the occurrence of the mite in the green-houses at Cornell College, Ithaca, N. Y.; Henderson for its occurrence in their green-houses, New York City; Dingee & Conard Co. for its occurrence at West Grove, Pa.

HOST PLANTS.

Order.	Common Name.	Techcical Name.	Authority.	Remarks.
Ranunculaceæ.	Jackman's Clematis.	Clematis Jackmanni.	Munson, Harvey.	College green-houses only.
Resedaceæ.	Mignonette.	Reseda odorata.	Munson.	" " " "
Caryoplyllaceæ.	Pink.	Dianthus caryoplyllus.	Munson.	" " " "
Malvaceæ.		Malope grandiflora.	Bailey.	
"	Indian Mallow.	Abutilon species.	Bailey.	
Geraniaceæ.	Stork's Bill.	Pelargonium species.	Henderson.	Plants of this family have not been attacked at the College nor in Orono.
"	Canary Bird.	Tropæolium peregrinum.	Munson.	
Leguminosæ.	Beans.		Bailey, Munson, Harvey.	At Orono beans out of doors badly affected.
Rosaceæ.	Ordinary Roses.		Havey, Durgee & Conard Co.	
"	Polyantha roses.		Bailey.	
"	Apricot.		Bailey.	Growing out of doors, near green-house.
Lythraceæ.	Cuphea.	Cuphea Llavæ.	Henderson.	
Onagraceæ.	Godelia.	Œnothera species.	Bailey.	
"	Ladies' Eardrop.	Fuchsia species.	Harvey.	Plants in Orono badly infested.
Passifloraceæ.	Gronadella.	Passiflora edulus.	Bailey.	
Cucurbitaceæ.	Cucumbers.	Cucumis sativus.	Munson, Bailey, Harvey.	
"	Musk Melon.	" Melo.	Munson.	College grounds.
Rubiaceæ.		Manettia species.	Henderson.	
"		Bouvardia species.	Henderson.	
Compositæ.	Feverfew.	Leucanthemum Parthenium.	Harvey.	Plants in Orono.
"		Chrysanthemum	Harvey, Henderson.	
Scrophulariaceæ.	Monkey-flower.	Mimulus tigrioides.	Munson.	
"	Musk Plant.	Mimulus Moschatus.	Munson.	
"	Slipper Flower.	Calceolaria species.	Henderson.	
Acanthaceæ.	Thumbergia.	Thumbergia alata.	Bailey.	
Verbenaceæ.	Verbena.	Verbena species	Henderson, Bailey, Harvey.	
		Lantana species.	Henderson.	
Labiatæ.	Sage.	Salvia splendens.	Munson.	
Borraginaceæ.	Heliotrope.	Heliotropum sp.	Henderson.	
Convolvulaceæ.	Cypress-vine.	Quamoclet vulgaris.	Munson.	
"	Moon-flower.	Ipomea noctophylon.	Munson.	
"	Morning Glory.	Pharbitis species.	Bailey.	
Solonaceæ.	Tomato.	Lycopersicum esculentum.	Munson, Bailey, Harvey,	
"	Pepino.	Solanum muricatum.	Bailey, Munson.	
"	Egg Plant.	Solanum melongena.	Bailey, Munson.	
"	Pepper.	Capsicum annuum.	Munson.	
"		Petunia species.	Harvey, Henderson.	
"	Wedding Bell.	Brugmansia arborea.	Harvey.	Very badly infested.
Euphorbiaceæ.	Castor Oil Plant.	Ricinus communis.	Harvey.	Badly infested.
	Hop.	Humulus lupulus.	Munson.	Out of doors.
Araceæ.	Calla.	Calla species.	Harvey.	
Smilaceæ.	Boston Smilax.	Myrsiphyllum asparagoides.	Bailey.	Very bad.
Liliaceæ.	Easter Lily.	Lilium Harrisii.	Harvey.	

REMEDIES.

The experience of Bailey, Henderson and Munson would lead one to conclude that there is no remedy at present known that is entirely effective.

Henderson writes us that one of the best remedies is Fir Tree Oil, and another very good one is Cole's Insect Destroyer but the cost of the latter almost prohibits its being used in large quantities. Prof. Bailey has had considerable experience with Fir Tree Oil but does not find it entirely satisfactory, though of considerable value.

Prof. Munson says he has used an alcoholic tincture of Pyrethrum and finds it quite satisfactory. There is a general belief that the red spider is readily destroyed by a copious use of water and will not flourish in a moist atmosphere. The impression of those who have had most experience with this mite, is that it may be very bad in a moist atmosphere. Prof. Munson relates one instance of a cucumber house where the plants were badly infested though the atmosphere was kept quite moist. We believe, however, that spraying the plants frequently with water, would help hold them in check by reducing the temperature. They seem to enjoy a high temperature.

Henderson believes an ounce of preventive is better than a pound of cure and if the plants are kept in good health they will resist the disease. He has frequently noticed that where plants become pot-bound it would make its appearance while others potted at the same time and shifted as the occasion required would be perfectly free from it, thus showing that the disease is altogether the result of imperfect conditions of growth. We have commented upon this elsewhere under the head of host plants.

Fir Tree Oil can be obtained from August Rölker & Sons, 136 W. 24th St., N. Y., at a cost of $3.25 per gallon, in five gallon lots, less ten per cent. for cash with order. It should be diluted about one hundred times with water and applied with a syringe or atomizer.

Alcoholic Tincture of Pyrethrum—Digest one part by weight of Pyrethrum (Dalmation Insect Powder) in four parts of commercial alcohol and apply the undiluted tincture to the foliage with an atomizer.

Cole's Insect Destroyer—Mr. Henderson says: "Is sold in half pint cans, price 50 cents. It is already for applying with an atomizer, such as is used for perfumery. Being very powerful a little is sufficient. For house plants we know of no better insecticide."

CUT WORMS.

We publish the following correspondence not to criticise Mr. Fowler but to call attention to the loose way in which names are applied to insects and the importance of being certain about the names of insects doing injury before applying remedial measures. We were glad to receive Mr. Fowler's letter for it offered us the opportunity of explaining the restricted use of the term cut-worm by entomologists and that it is not used in the brood sense that includes any kind of worm found feeding upon the roots of farm crops. We will always be pleased to answer questions or explain differences of opinion.

CORRESPONDENCE.

SEARSMONT, ME., Sept. 9, '92.

MR. F. L. HARVEY:

DEAR SIR:—Part V of Ag. Rept. is at hand and in reading about cut-worms I think my experience may help some one. Cut-worms used to trouble my beets and corn. I noticed when green manure was used in the spring and left uncovered for any length of time—say half a day—a yellow fly such as one sees around manure piles used to fly around and on the manure in the drills, and produce an abundant crop of dark gray or brown or nearly black cut-worms. When manure was hauled from *dark* barn cellar and *immediately covered* found no cut-worms. So by keeping manure in cellar until wanted for use and keeping cellar dark so no flies would stay there and covering manure immediately I am clear of the pest. Whoever uses barn-yard manure, or manure that is stacked will find plenty of them. For proof examine droppings of cattle in pasture and around buildings and enough of these pests will be found at some stage in the manure. Hoping this may help some as a suggestion I send it.

Very truly,
MOSES A. FOWLER.

The following is our answer somewhat changed and extended for publication:

ORONO, ME., Sept. 23, '92.

MR. MOSES A. FOWLER:

DEAR SIR:—You and I have different ideas about cut-worms. According to my understanding the term cut-worm is *restricted* by entomologists to the larval or caterpillar stage of Hawk Moths such as I have figured in my Report, Figs. 4, 6 and 7 and is not used in the broad sense suggested by you, which would include all worms that eat or cut the roots or other parts of farm crops.

The yellow insects to which you refer belong to the *Order Dieptera* or *two-winged flies*, related to the house-fly and in their worm stage should be called *maggots*. Our root crops are often affected by maggots, as the maggot of the Radish Fly and that of the Onion Fly, but these do not cut off the plants like cut-worms but bore into the roots. The moths of cut-worms lay their eggs near the roots on grass in meadows and pastures and *not* in manure piles. The white *grubs* found in manure are the larvæ or worm stage of beetles (Coleoptera) like the May Beetle and related species. Though the housing of manure is to be recommended to prevent leaching and no doubt if properly protected would be less infested with manure loving larvæ, but cut-worms do not seek such a nidus for their eggs.

Your crops were probably affected by the maggot of some fly, or more probably the grub of some beetle, or possibly by genuine cut-worms that had crawled from adjoining meadow or pasture lands. It may have been the grub of the *Three-toothed Aphonus* mentioned in my Report, 1891, p. 199, as cutting corn. The sources of insect pests are so many, and the species that feed upon our farm crops so numerous, it is important that each case of injury be carefully examined.

If you will send me in a small box the worms you call cutworms I will take pleasure in examining them and tell you whether they are correctly named.

Very truly yours,
F. L. Harvey,
Entomologist for Station.

REPORT OF METEOROLOGIST.

PRESIDENT FERNALD, METEOROLOGIST TO THE STATION.

MAINE EXPERIMENT STATION.

Lat. 44°, 54', 2", N. Long. 68°, 40', 11", W.

In presenting my fourth annual report as Meteorologist to the Maine Experiment Station, I desire to state definitely as in former reports, that the object sought "is not so much the observing and reporting of general atmospheric phenomena as the careful study of the special meteorological conditions which are more or less intimately connected with practical agriculture."

In order to secure trustworthy results, it is necessary that observations directed toward a solution of any problem in Meteorology be continued through a series of years. Accordingly, in presenting my first report, a plan of summarizing observations and deducing conclusions was adopted, which should be suited to the presenting of like data covering any number of years.

The present report is made in accordance with the prearranged plan and includes in addition to the results of the three preceding years those obtained from about eleven thousand observations taken during the year 1892.

The deductions, therefore, of this report are based upon more than forty thousand independent observations.

The instruments have remained unchanged in position during the four years for which this report is made, and the greater part of the observations have been taken by one observer.

In presenting the arrangement of instruments and other necessary descriptive or explanatory data, I draw freely from my report of last year, simply adapting its statements so far as needful to the more extended period of time.

The most of the instruments employed were manufactured by H. J. Green, of Brooklyn, N. Y. Mr. Robert H. Fernald of

Orono, has been observer during the four years that this work has been carried on. In this report the results of observations made during the years 1889, 1890, 1891 and 1892, are combined.

The several problems considered appear in definite order, in the following pages. The first to which attention has been given, is a determination of the percentage of moisture in forest as compared with that in open field.

The arrangement of instruments for this investigation is herewith submitted.

Hygrometer No. 1 is placed in a wooden stand constructed for thermometrical instruments and located in the open field remote from buildings. Hygrometer No. 2 also is enclosed in a wooden box, perforated to allow a free circulation of air, and located also in the open field. Hygrometer No. 3 is also enclosed in a perforated box attached to a tree in a moderately dense forest. Hygrometer No. 4 is placed in a similar box attached to a tree in a portion of the forest a little more open than that in which No. 3 is located, but near which is a running brook except during the driest part of the summer.

Each hygrometer is about four feet above the surface of the ground. Readings are taken three times daily, at 7 A. M., at 1 P. M., and at 7 P. M., local time.

Observations were commenced April 5, 1889 and they have been continued through the growing seasons of 1889, 1890, 1891 and 1892.

The monthly averages are given in the following tables on the scale of 100.

Percentages of Moisture.

HYGROMETER NO. 1.—IN OPEN FIELD.

	1889.			1890.			1891.			1892.			
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	Mean
April	81	53	66	74	50	58	85	61	67	74	47	57	64
May	84	60	71	81	62	74	82	57	67	78	63	67	71
June	88	67	81	83	72	75	83	62	71	86	69	74	76
July	85	65	75	85	74	79	87	61	72	84	57	69	74
August	95	70	80	90	63	77	89	67	83	92	70	8[illegible]	80
September	93	68	83	93	76	85	92	67	84	97	61	81	82
October	94	66	79	90	62	79	90	63	80	86	64	76	77
Mean results	89	64	76	85	66	75	87	63	75	85	62	72	75

HYGROMETER NO. 2.—IN OPEN FIELD.

	1889.			1890.			1891.			1892.			
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	Mean
April	78	52	65	70	46	56	84	62	70	74	50	63	64
May	80	53	68	78	61	74	80	55	68	78	63	70	69
June	84	66	74	78	68	75	82	62	73	84	67	73	74
July	79	60	69	80	63	71	86	62	75	82	55	67	71
August	87	67	75	88	62	73	87	65	80	90	68	81	77
September	91	60	81	91	67	83	91	67	85	92	60	81	79
October	93	66	81	91	62	79	91	65	82	83	64	77	78
Mean results	85	61	72	82	61	73	86	63	76	83	61	73	73

HYGROMETER NO. 3.—IN FOREST.

	1889.			1890.			1891.			1892.			
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	Mean
April	81	62	60	78	61	69	90	73	77	83	63	71	72
May	83	63	73	87	74	81	86	68	75	86	71	76	77
June	89	80	84	87	77	82	88	81	84	91	78	82	73
July	94	86	91	93	85	83	92	80	85	92	74	81	86
August	91	89	93	94	80	84	95	81	88	96	85	89	89
September	96	88	92	96	87	92	95	81	92	96	77	88	88
October	96	90	90	96	86	90	92	77	86	90	80	85	88
Mean results	90	80	85	90	79	83	91	77	84	91	75	82	82

HYGROMETER NO. 4.—IN FOREST.

	1889.			1890.			1891.			1892.			
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	Mean
April	83	65	77	79	60	71	91	74	82	84	65	75	75
May	89	66	80	88	73	84	87	69	78	87	74	77	79
June	92	81	86	89	77	84	90	74	82	92	79	84	84
July	93	79	87	91	79	85	93	79	86	94	72	80	85
August	95	86	91	91	78	85	96	78	90	97	86	90	89
September	96	83	90	97	86	92	96	79	92	95	76	87	88
October	96	80	90	94	80	89	92	76	87	91	79	86	87
Mean results	92	77	86	90	76	84	92	75	85	91	76	81	84

Percentages of Moisture.

RESULTS FOR 1889, 1890, 1891 AND 1892, COMBINED.

	7 A. M.	1 P. M.	7 P. M.	Mean
Hygrometer No. 1, in open field.	86	64	75	75
" " 2, " " "	84	62	73	73
" " 3, in forest,	90	78	84	84
" " 4, " "	91	76	84	84

Regarding the mean results from hygrometers Nos. 1 and 2 as indicating percentages for the open field, we have the following summary of results:

	7 A. M.	1 P. M.	7 P. M.	Mean
Percentages of moisture, open field,	85	63	74	74

Regarding the mean results from hygrometers Nos. 3 and 4 as indicating percentages for forests only moderately dense, we have the following summary results:

	7 A. M.	1 P. M.	7 P. M.	Mean
Percentages of moisture, forest,	91	77	84	84

Comparing results, open field and forest, we have excess of moisture in forest above that in open field expressed in percentages.

7 A. M.	1 P. M.	7 P. M.	Mean
6	14	10	10

It thus appears from observations covering the period of growth of four years, that the excess of moisture in forest above that of open field in the morning, amounts to but 6 per cent., while in the middle of the day it rises to 14 per cent., and at night-fall drops down to 10 per cent., and that the mean excess for the day is 10 per cent. In a very dense forest the percentage of excess would undoubtedly rise much higher. The presence of patches of forest in any region exerts a marked influence on the hygroscopic conditions of the atmosphere, and this condition, in turn, is an important factor in the growth of vegetation.

SOIL TEMPERATURES.

In this investigation a knowledge of the temperature of the soil at different depths, during the growing season, is sought, and ultimately the law which represents the rate of change of temperature at different depths.

The periods covered by the experiment are from May 1 to Nov. 1, 1889, from April 1 to Nov. 1, 1890, 1891 and 1892, with thermometers placed in the soil to the depths of 1, 3, 6, 9, 12, 24 and 36 inches.

The thermometers have been allowed to remain in place during the winters intervening between the periods of observation.

Their location is in the open field, near hygrometer No. 2, in the tract of land assigned to the Station for experimental purposes and devoted to farm experiments. The character of the soil is regarded, therefore, as representative of that on which the field experiments by the Station are carried on.

A summary of results for the four seasons by monthly averages is given in the annexed tables.

SOIL THERMOMETERS—1889.

	1 inch.			3 inches.			6 inches.			9 inches.			12 inches.			24 inches.			36 inches.		
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
May	51.77	62.92	59.20	51.50	60.33	59.70	52.92	55.21	57.04	53.49	53.31	55.44	52.46	52.15	53.21	48.84	49.06	49.01	46.28	46.42	46.48
June	61.94	71.54	67.56	61.38	69.62	67.76	61.85	68.43	65.35	62.07	62.27	63.51	61.26	61.10	61.79	57.23	57.45	57.41	54.36	54.54	54.52
July	63.41	72.10	68.89	63.10	70.86	69.54	64.25	66.51	67.48	64.93	65.15	66.27	64.30	64.02	64.29	60.99	61.14	61.06	58.50	58.63	58.57
August	61.18	69.59	66.90	61.75	68.91	68.01	62.90	64.83	66.01	59.82	63.88	65.01	63.31	63.10	63.31	60.96	61.10	60.97	59.16	59.31	59.23
September	57.11	61.56	61.45	57.74	63.01	62.89	59.47	60.25	61.29	60.29	60.20	60.93	60.30	60.21	60.04	59.42	59.51	59.36	58.40	58.51	58.37
October	42.80	43.59	45.50	43.80	47.31	46.72	46.06	46.48	47.12	47.21	46.97	47.32	48.17	47.83	47.85	50.63	50.65	50.54	51.66	51.66	51.61
Mean	56.37	63.55	61.58	56.54	63.34	62.44	57.91	60.28	60.71	57.97	58.63	59.75	58.30	58.06	58.41	56.34	56.48	56.39	54.84	54.73	54.79
Mean temperature for six months		° 60.50			° 60.77			° 59.63			° 58.78			° 58.26			° 56.40			° 54.79	

SOIL THERMOMETERS—1890.

	1 inch.			3 inches.			6 inches.			9 inches.			12 inches.			24 inches.			36 inches.		
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
April	33.74	40.35	36.89	36.53	38.12	37.11	34.32	34.55	35.13	33.56	34.09	34.29	34.57	34.55	34.75	34.81	34.83	34.95	35.31	35.39	35.37
May	50.38	54.80	51.53	47.63	54.67	53.40	49.40	50.26	51.49	49.29	49.27	49.72	48.80	48.68	48.82	45.72	45.55	45.84	43.27	43.72	43.77
June...........	56.06	60.05	59 68	55.91	60.44	60.07	56.11	56.78	57.55	55.85	55.95	56.32	55.99	55.95	55.82	53.52	53.18	53.27	50.85	50.94	50.96
July...........	62.82	64.69	64.03	62.66	66.93	66.81	65.91	64.11	64.87	62.85	62.95	63.88	62.70	62.60	62 78	58.77	58.84	58.77	56.25	56.28	56.34
August...........	61.80	68.20	67.28	62.15	67.60	67.41	63.69	65.08	66.26	63.91	64.16	64.83	63.87	63.84	63.91	61.72	62.09	61.34	59.43	59.40	59.39
September.......	56.51	59 83	59.43	57.44	58.93	59.62	58.21	58.56	59.34	58.36	58.30	58.59	58.73	58.58	58.56	58.15	58.43	58.37	57.73	58.05	57.65
October...........	45.37	47.17	46.67	45 77	47.16	46.76	47.09	47.10	47.23	47.40	47.32	47.66	48.81	48.72	48.59	51.08	50.97	50.86	52.07	52.04	52.00
Mean...........	52.38	56.44	55.07	52.58	56.29	55.88	53.54	53.78	54.55	53.03	53.15	53.61	53.35	53.27	53.32	51.97	51.99	51.98	50.70	50.83	50.78
Mean temperature for seven months,	54.63°			54.92°			53.96°			53.26°			53.31°			51.96°			50.77°		

SOIL THERMOMETERS—1891.

	1 inch.			3 inches.			6 inches.			9 inches.			12 inches.			24 inches.			36 inches.		
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
April	37.70	42.48	42.34	37.69	42.32	42.41	39.03	39.81	41.40	37.04	37.68	39.93	38.80	38.69	38.58	36.87	36.96	37.01	37.46	37.53	37.53
May	46.54	54.03	52.93	54.31	53.73	52.87	47.49	49.27	51.24	47.83	48.22	49.36	47.64	47.63	47.90	45.00	45.14	45.20	43.78	43.49	43.50
June	59.18	65.42	64.53	59.10	64.80	64.21	59.43	60.40	61.73	59.23	58.96	59.67	58.79	58.37	58.60	54.00	54.12	54.11	51.25	51.35	51.37
July	62.70	68.59	67.44	62.78	67.56	67.10	63.08	64.23	65.18	63.17	63.18	62.85	62.39	62.14	62.44	58.16	58.25	58.26	55.75	55.82	55.83
August	62.45	69.07	67.46	62.59	68.03	67.45	63.98	64.97	66.62	63.93	63.99	64.99	63.80	63.59	63.91	60.72	60.83	60.76	58.66	58.75	58.37
September	58.82	62.88	62.41	59.00	62.85	62.55	60.43	60.99	62.00	60.57	60.48	61.21	60.77	60.60	60.73	59.67	59.70	59.65	58.53	58.61	58.36
October	46.03	48.78	47.94	46.20	48.86	48.22	48.20	48.54	48.81	48.78	48.57	49.17	50.02	49.86	49.77	52.74	52.67	52.53	53.61	53.58	53.50
Mean	53.35	58.75	57.86	54.52	58.31	57.83	54.52	55.46	56.71	54.45	54.44	55.34	54.60	54.41	54.56	52.45	52.52	52.50	51.29	51.30	51.49
Mean temperature for seven months,	° 56.65			° 56.89			° 55.56			° 54.74			° 54.52			° 52.49			° 51.36		

SOIL THEMOMETERS—1892.

	1 inches.			3 inches.			6 inches.			9 inches.			12 inches.			24 inches.			36 inches.		
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
April............	38.07	42.65	42.86	38 89	41.17	42.16	39.46	39.85	41.02	38.66	38.93	40.19	39.15	39.08	39.38	37.72	37.85	37.87	37.25	37.30	37.29
May............	46.35	50.92	51.12	46.88	50.81	51.16	47.33	48.32	49.67	47.40	47.53	48 22	46.92	46.88	47.16	44.44	44.76	44.65	42.97	43.16	43.20
June............	58.10	63.02	63.08	58.46	62 89	62.86	58.45	59.50	60.44	58.86	58.59	59.89	58.67	58.64	58.79	54.15	54.19	54.14	51.29	51.41	51.44
July............	63.48	68.29	67.67	63.61	68.18	67.85	63.74	64.28	65.13	63.58	63.47	64.57	63.66	63.36	63.81	59.15	59.24	59.25	56.47	56.54	56.57
August	63.39	68.06	67.87	63.42	69.56	67.67	64.29	65.35	66.04	64.21	64.42	65.34	64.45	64.30	64.62	61.89	61.96	61.85	59.93	60.00	59 99
September	55.84	59.79	59.51	56.17	59.91	59.59	57.54	58.26	58.81	57.78	57.65	58.38	58 37	58.09	58.27	58.14	58.25	58.18	57.99	57.65	57.61
October..........	44.61	46.64	46.85	44.60	46.56	46.82	46 87	46.82	47.29	46.80	46.62	46.34	47.97	47.83	47.85	50.82	50.80	50.76	51.93	51.88	51.87
Mean............	52.83	57.05	56.99	53.08	56.94	56.87	54.24	54.63	55.49	53.90	53.89	54.70	54 17	54.02	54.27	52.33	52.44	52.39	51.12	51.13	51.14
Mean temperature for seven months,	° 55.62			° 55.63			° 54.79			° 54.16			° 54.15			° 52.39			° 51.13		

In order that comparisons may be made between soil temperatures at different depths and the air temperatures during the same months and in the same locality, the following tables are added:

THERMOMETER IN THE OPEN AIR.

(Locality the same as that of the soil thermometers.)

1889.

	7 A. M.	1 P. M.	7 P. M.	Mean.
	°	°	°	°
May,	52.95	68.30	59.47	60.24
June,	63.36	74.27	68.07	68.57
July,	65.12	75.75	70.86	70.58
August,	59.97	74.20	66.81	66.99
September,	54.39	70.86	61.55	62.27
October,	37.41	52.80	44.05	44.75
Mean,	55.53	69.36	61.80	62.23

1890.

	7 A. M.	1 P. M.	7 P. M.	Mean.
	°	°	°	°
April,	35.76	49.02	42.55	42.44
May,	49.16	60.60	53.58	54.45
June,	57.95	67.64	62.76	62.78
July,	67.10	76.19	71.85	71.71
August,	61.50	73.78	68.84	68.04
September,	52.04	66.16	58.52	58.91
October,	37.70	53.19	45.63	45.51
Mean,	51.60	63.80	57.68	57.69

1891.

	7 A. M.	1 P. M.	7 P. M.	Mean.
	°	°	°	°
April,	36.33	48.26	43.64	42.74
May,	47.07	61.75	53.30	54.04
June,	58.28	72.42	65.38	65.36
July,	64.08	76.05	68.81	69.65
August,	62.07	74.94	67.47	68.16
September,	56.13	69.72	61.80	62.55
October,	38.11	54.02	45.56	45.90
Mean,	51.72	65.31	57.99	57.34

1892.

	7 A. M.	1 P. M.	7 P. M.	Mean.
	°	°	°	°
April,	37.29	51.93	45.10	44.77
May,	47.00	58.95	54.19	53.38
June,	58.74	70.65	67.29	65.56
July,	65.58	78.54	71.92	72.11
August,	61.16	74.15	67.46	67.50
September.	53.33	68.19	56.52	59.68
October,	40.98	51.65	45.13	45.94
Mean,	52.05	64.87	57.38	58.43

TABLES SHOWING CHANGES OF TEMPERATURE IN THE SOIL FOR INCREASED DEPTHS.

1889.

Depth of Thermometer.	Mean temperature for 6 mos., May to Oct. inclusive.	Difference in mean temperatures.	Changes in temperature for one inch.
	°	°	°
1 inch	60.50		
3 inches	60.77	+0.27	+0.13
6 inches	59.63	—1.14	—0.38
9 inches	58.78	—0.85	—0.28
12 inches	58.26	—0.52	—0.17
24 inches	56.40	—1.86	—0.15
36 inches	54.79	—1.61	—0.13

1890.

Depth of Thermometer.	Mean temperature for 7 mos., April to Oct. inclusive.	Difference in mean temperatures.	Changes in temperature for one inch.
	°	°	°
1 inch	54.63		
3 inches	54.92	+0.29	+0.14
6 inches	53.96	—0.96	—0.32
9 inches	53.26	—0.70	—0.23
12 inches	53.31	+0.05	+0.02
24 inches	51.96	—1.35	—0.11
36 inches	50.77	—1.19	—0.10

1891.

Depth of Thermometer.	Mean temperature for 7 mos., April to Oct. inclusive.	Difference in mean temperatures.	Changes in temperature for one inch.
	°	°	°
1 inch	56.65		
3 inches	56.89	+0.24	+0.12
6 inches	55.56	—1.33	—0.44
9 inches	54.74	—0.82	—0.27
12 inches	54.52	—0.22	—0.07
24 inches	52.49	—2.03	—0.17
36 inches	51.36	—1.13	—0.09

1892.

Depth of Thermometer.	Mean temperature for 7 mos., April to Oct. inclusive.	Difference in mean temperatures.	Changes in temperature for one inch.
	°	°	°
1 inch	55.62		
3 inches	55.63	+0.01	+0.003
6 inches	54.79	—0.84	—0.28
9 inches	54.16	—0.63	—0.21
12 inches	54.15	—0.01	—0.003
24 inches	52.39	—1.76	—0.14
36 inches	51.13	—1.26	—0.10

An examination of the tables shows that the soil responds readily to the daily heat of the sun to the depth of three inches, less readily to the depth of six inches, in a moderate degree only to the depth of nine inches, and very slightly below twelve inches. To the depth of three inches the range between the morning and the midday observations has been as high as fifteen degrees. The mean daily range at the depth of 1 inch during the period of observations was 5°.22; at the depth of three inches, 4°.54; at the depth 6 inches, 1°.81; at the depth of 9 inches, 1°.02, and 12 inches very slight.

At the depth of 3 inches, the average temperature of the soil was somewhat higher than at the depth of 1 inch. The surface soil averaged about five degrees warmer than the soil 36 inches below the surface.

The rate of reduction of temperature with depth below the layer three inches from the surface is shown in a general way in the foregoing tables.

This rate is probably in accordance with a simple law which can be expressed by a mathematical formula, variable, undoubtedly, for different soils. However, on examining the "changes in temperature for one inch" in the foregoing tables, it will be noticed that the rate has been clearly vitiated since 1889 by the record of the nine inch thermometer.

The anomalous action of this instrument is accounted for by the fact, that at the end of the year 1889, the nine inch thermometer first used was broken and a new one was substituted. The contact of the latter with the soil was not the same as that of the former, nor has it been the same as that of the other instruments which have not been disturbed in the four years.

This accident, although vitiating the results of the present investigation, is not without its value, since it clearly indicates the need of maintaining uniform conditions in carrying on a work of the nature and delicacy of that for which soil thermometers are employed.

Comparing soil temperatures with air temperatures during the four seasons, the following mean results appear: At the depth of 1 inch, the temperature of the soil was lower than at that of the air by 2°.32; at the depth of 3 inches, by 2°.12; 6 inches, by 3°.22; 9 inches, by 3°.94; 12 inches, by 4°.12; 24 inches, by 5°.86, and at the depth of 36 inches, by 7°.16.

TERRESTRIAL RADIATION.

The heat radiated from the surface of the earth during the night reduces its temperature several degrees below that of the surrounding atmosphere. The amount of this radiation or the consequent reduction of temperature is approximately shown by comparing the readings of a terrestrial radiation thermometer with those of a minimum thermometer. In obtaining data for the comparison given below, the minimum thermometer was four feet above the ground and the terrestrial radiation thermometer was within six inches of its surface. The results are based on monthly averages from May to October inclusive, 1889, from April to October inclusive, 1890, 1891 and 1892.

TABLE SHOWING LOSS OF HEAT BY TERRESTRIAL RADIATION.

1889.

	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
	°	°	°	°	°	°	°
Mean of minimum temperatures......	46.63	53.25	55.08	53.65	49.07	33.91	48.50
Mean of Temp. from Ter. Rad. Ther..	38.48	49.20	50.59	47.66	44.60	28.48	43.17
Loss of heat by radiation............	8.15	4.05	4.49	5.39	4.74	5.43	5.33

1890.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
	°	°	°	°	°	°	°	°
Mean of minimum temperatures......	29.17	42.52	48.71	53.61	53.52	45.32	36.05	44.13
Mean of Temp. from Ter. Rad. Ther..	19.95	37.10	42.10	44.55	46.25	38.40	27.14	36.50
Loss of heat by radiation....	8.22	5.42	6.61	9.06	7.27	6.92	9.91	7.63

1891.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
	°	°	°	°	°	°	°	°
Mean of minimum temperatures......	30.22	37.67	49.18	53.15	54.07	49 23	34.95	44.07
Mean of Temp. from Ter. Rad. Ther..	24.45	29.09	40.87	43.94	47.40	42 22	25.60	36.23
Loss of heat by radiation...........	5.77	8.58	8.31	9.21	6.67	7.01	9.35	7.84

1892.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
	°	°	°	°	°	°	°	°
Mean of minimum temperatures......	30.32	39.08	50.73	54.65	55.77	45.69	34.47	44.39
Mean of Temp. from Ter. Rad. Ther..	22.29	30.64	41.89	45.05	46.38	37.45	28.02	35.96
Loss of heat by radiation............	8.03	8.44	8.84	9.60	9.39	8.24	6.45	8.43

On cloudy nights the difference in the reading of the two thermometers is small, and on exceptionally clear (dry) nights it is a maximum. The greatest range observed was 19.5° Occasionally, the reading of the radiation thermometer is higher than that of the minimum thermometer, showing that the moist air at such times, resting upon the surface of the ground, serves as a warm blanket, and that the amount of heat then absorbed is greater than that radiated. The table above shows that the mean radiation for the four seasons was 7.31°.

SOLAR RADIATION.

The temperature of the atmosphere does not indicate the intensity of the sun's heat, as only a small percentage is absorbed as the rays are transmitted through the air. The maximum thermometer in the shade, therefore, does not give the intensity of solar radiation ; neither does exposure of an ordinary thermometer to the direct rays of the sun, in consequence of the cooling effects of draughts of air. In order to avoid the effects of currents of air, the *vacuum solar radiation thermometer* has been devised. "This consists of a blackened bulb radiation thermometer inclosed in a glass tube and globe, from which all air is exhausted. Thus protected from the loss of heat which would ensue if the bulb were exposed, its indications are from 20° to 30° higher than when placed side by side with a similar instrument with the bulb exposed to the passing air." By the use of this instrument the amounts of solar radiation at different places and in different seasons at the same place are rendered comparable. The relations of solar-intensity, as distinct from temperature of the air to the growth and maturity of crops, are worthy of careful investigation. High solar intensity maintained through the latter part of the growing season has an important bearing upon the complete ripening of vegetables and fruits and likewise upon their keeping qualities. From the wide range of observations undertaken by Experiment Stations with radiation thermometers, important deductions may reasonably be expected. I subjoin tables of results from the maximum thermometer and the thermometer for solar radiation, expressed in monthly averages.

1889.

	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
	o	o	o	o	o	o	o
Mean of readings, Sun Ther......	133.02	134.22	139.55	137.56	122.79	105.86	128.83
Mean of maximum temperatures.....	67.85	73.45	75.30	73.72	71.23	52.78	69.05
Excess of solar intensity.............	65.17	60.77	64.25	63.84	51.56	53.08	59.78

1890.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean
	o	o	o	o	o	o	o	o
Mean of readings, Sun Ther..	119.15	119.45	128.81	139.37	138.25	114.94	112.52	124.65
Mean of maximum Temp.....	49.37	61.16	68.01	76.53	74.67	62.32	55.61	64.38
Excess of solar intensity.......	69.82	58.29	60.80	62.84	63.58	49 62	56.92	60.27

1891.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
	o	o	o	o	o	o	o	o
Mean of readings, Sun Ther..	106.78	119.19	129.44	140.35	129 55	121.65	99.55	120.93
Mean of maximum Temp.....	50.65	62.48	72.17	76.68	75.39	69.84	54.18	65.91
Excess of solar intensity......	56.13	56.71	57.27	63.67	54.16	51.81	45.37	55.02

1892.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
	o	o	o	o	o	o	o	o
Mean of readings, Sun Ther..	113.32	112.47	127.11	139.50	128.25	123.82	97.62	120.30
Mean of maximum Temp.....	53.93	62.22	72.87	82.28	75.07	68.74	53.16	66.90
Excess of solar intensity......	59.39	50.25	54.24	57.22	53.18	55.08	44.46	53.40

From the above records it appears that the average excess of solar intensity above that given by the maximum thermometer for the growing periods of 1889, 1890, 1891 and 1892 was 57.12°.

The season of greatest excess in this regard was that of 1890, a season noted for the perfect maturity of fruits and vegetables.

AMOUNT OF SUNSHINE.

The amount of sunshine as an essential factor in crop production is worthy of observation and record. Observations were commenced May 1, 1890, and the table below furnishes the summary for the six months following and for seven months, April to November, 1891, and for seven months, April to November, 1892.

BRIGHT SUNSHINE IN HOURS.

1890.

	May.	June	July.	Aug.	Sept.	Oct.	Mean.
Sunshine,	180	186	216	193	126	133	172
Hours per day, mean,	5.8	6.2	7.0	2.6	4.2	3.3	5.6

1891.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
Sunshine,	174	207	217	259	225	234	154	209
Hours per day, mean,	5.8	6.7	7.2	8.4	7.3	7.8	5.0	6.9

1892.

	April.	May.	June.	July.	Aug.	Sept.	Oct.	Mean.
Sunshine,	228	123	198	294	173	259	149	203
Hours per day, mean,	7.6	4.0	6.6	9.5	5.6	8.6	4.8	6.7

During the period covered by the above table, the average hours of bright sunshine per day were 6.4 or 46 per cent. of the possible amount.

WIND AND RAIN.

The velocity of the wind has been determined by a Robinson's Anemometer, with electrical recording apparatus, attached to the Experiment Station building, and the amount of rain by means of a guage, signal service pattern, located in the same plat as the soil thermometers.

1889.

	WIND.		RAIN.
	Mean distance travelled per day. Miles.	Velocity per hour. Miles.	Amount. Inches.
April,	253.93	10.58	1.36
May,	189.83	7.91	1.61
June,	171.12	7.13	4.86
July,	200.33	8.34	3.27
August,	139.35	5.81	1.69
September	198.06	8.25	2.10
October,	194.31	8.09	3.96
Mean,	192.42	8.02	Total, 18.85

1890.

	WIND.		RAIN.
	Mean distance travelled per day. Miles.	Velocity per hour. Miles.	Amount. Inches.
April,	241.83	10.07	1.98
May,	235.14	9.79	10.13
June,	230.40	9.60	3.78
July,	166.28	6.95	3.84
August,	187.03	7.65	5.39
September,	155.50	6.45	4.21
October,	189.01	7.85	3.19
Mean,	200.74	8.34	Total, 32.52

1891.

	Wind.		Rain.
	Mean distance travelled per day. Miles.	Velocity per hour. Miles.	Amount. Inches.
April,	210.55	8.77	3.13
May,	206.25	8.59	2.76
June,	182.71	7.61	3.13
July,	185.44	7.73	3.36
August,	169.58	7.07	4.38
September,	162.07	6.75	3.50
October,	191.92	8.00	2.81
Mean,	186.93	7.79	23.07

1892.

	Wind.		Rain.
	Mean distance travelled per day. Miles.	Velocity per hour. Miles.	Amount. Inches.
April,	244.99	10.21	1.09
May,	262.23	10.93	1.99
June,	197.87	8.24	5.66
July,	199.50	8.31	1.88
August,	168.36	7.02	6.11
September,	185.28	7.72	3.43
October,	199.13	8.26	1.46
Mean,	208.19	8.67	21.62

For the full year 1890, the mean daily velocity of the wind was 211.16 miles and the mean hourly velocity, 8.90 miles; for the full year 1891, the corresponding velocities were respectively 214.82 miles and 8.95 miles; and for the full year 1892, 217.33 miles and 9.05 miles.

The rain-fall in May, 1890, amounting to 10.13 inches was larger than in any other month in twenty-four years.

CONCLUSION.

The foregoing summarized report, although embodying all the data obtained by four years' observations, conveys but an imperfect idea of the daily requirments and nature of the work in progress.

By way of presenting its varied character more fully, as in former years, I append the complete records for one month, selecting for the current report the month of October 1892.

HYGROMETER NO. 1.—IN OPEN FIELD.

OCTOBER, 1892.

Day.	7 A. M.				1 P. M.				7 P. M.			
	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.
	°	°	°	°	°	°	°	°	°	°	°	°
1.	52.2	45.2	37	57	50.5	44.5	37	61	44.2	39.4	32	65
2.	41.8	37.0	29	63	49.5	41.2	29	46	43.0	38.6	32	67
3.	29 8	29.0	26	91	46.5	41.0	34	62	43.0	42.5	42	96
4.	46.5	46.2	45	98	51.0	48.7	46	85	48.8	48.1	47	95
5.	34.8	34 8	34.8	100	49.8	44.4	38	65	45.2	42.0	39	77
6.	41.5	38.8	36	79	49.0	42.9	36	59	44.2	40.2	35	70
7.	44.2	41.5	38	80	59.0	52.8	48	66	50 0	48.0	46	87
8.	44 8	44.0	42	90	63.4	58.7	51	55	58.2	54.8	52	81
9.	50.1	50.0	50	99	45.8	44.0	42	87	42.4	40.8	39	87
10.	30.3	30.0	28	97	50.1	42.2	31	50	48.0	41.5	33	56
11.	39.7	38.0	36	86	51.0	42.5	31	47	38.8	35.0	29	69
12.	30.0	28.8	27	87	49.0	42.4	34	56	44.2	38.8	30	60
13.	28.0	28.0	28	100	44.8	43.8	42	92	49.4	48.3	47	92
14.	55.0	52.0	50	82	65.7	58.0	51	55	57.0	51.3	47	68
15.	45.0	43.0	41	85	60.1	51.0	43	52	49.8	45.7	42	73
16.	52.2	51.2	50	94	53.2	53.0	52	99	53.4	52.9	52	97
17.	40.0	37.0	33	76	48.4	41.2	33	53	37.2	35.6	33	86
18.	25.6	25.2	24	95	52.8	44.5	34	50	41.1	39.6	37	88
19.	48.7	48.2	48	97	52.0	51.4	51	96	51.2	50.6	50	96
20.	42.4	41.1	40	90	52.8	44.0	33	48	43.0	38.5	32	66
21.	37.8	34.3	29	70	50.7	40.0	25	35	41.7	36.5	29	60
22.	44.9	39 0	30	58	55.2	43.8	28	37	47.7	41.5	38	59
23.	45.1	42.2	39	79	49.9	47.5	45	84	46.6	43.0	40	75
24.	40.0	37.0	33	76	46.1	40.5	33	60	43.8	39.1	33	65
25.	37.7	36.2	34	87	50.9	44.5	37	60	47.9	42.6	36	61
26.	38.8	38.0	37	94	46.7	43.0	40	74	44.7	43.0	42	87
27.	40.3	40.2	40	99	44.9	43.1	43	94	43.6	41.0	38	80
28.	37.3	36.0	35	89	49.5	43.6	37	62	43.7	40.0	36	72
29.	30.0	29.3	28	91	43.8	39.9	35	71	41.2	40.0	39	90
30.	36.2	35.3	34	92	48.0	40.9	32	52	42.1	38.0	33	68
31.	31 0	30.0	28	90	43.2	38.9	32	68	40.3	36.8	31	72
Means.				86				64				76
Mean for month.								75				

HYGROMETER NO. 2.—IN OPEN FIELD.

October, 1892.

Day.	7 A. M.				1 P. M.				7 P. M.			
	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.
	°	°	°	°	°	°	°	°	°	°	°	°
1.	53.2	45.0	35	51	51.0	42.0	30	45	43.2	35.3	21	42
2.	43.1	37.2	28	56	48.8	40.2	28	44	39 5	35.7	30	70
3.	32.5	32.0	30	95	47.3	44.3	41	79	43.0	42.2	41	94
4.	46.9	46.5	46	97	52.1	50.3	49	89	47.8	47.2	47	95
5.	35.7	35.7	35.7	100	50.5	45.0	38	64	45.9	41.7	37	70
6.	42.2	39.1	35	76	49.5	43.5	37	61	44.2	40.3	35	71
7.	45.2	42.3	39	79	60.8	53.3	47	61	50.2	48.1	46	86
8.	48.0	47.1	46	94	68.0	59.1	53	59	52.5	49.7	47	85
9.	50 0	50.0	50	100	46.2	44.2	42	85	39.8	39.0	37	94
10.	30.5	30.3	29	98	50.2	42.5	32	51	47.1	41.0	33	59
11.	40.0	38.5	36	88	52.3	44.5	34	52	38.1	34.8	29	72
12.	33.0	32.0	30	92	49.0	43.0	36	60	41.8	38.0	33	71
13.	28.9	28.8	28	99	45.8	44.3	43	89	49.2	48.2	47	93
14.	55.6	51.8	49	78	67.8	57.9	51	55	56.5	51.8	49	73
15.	47.5	45.8	44	88	64.0	53.8	46	50	50.2	46.0	42	72
16.	52.7	51.2	50	91	53.8	53.0	51	95	54.0	53.2	52	95
17.	40.0	37.0	33	76	49.1	42.5	34	56	35.3	33.9	31	87
18.	27.7	27.0	25	92	54.7	41.6	23	28	40.0	39.2	38	94
19.	49.0	48.5	48	97	52.1	51.5	51	96	51.2	50.4	49	95
20.	43.6	41.2	38	82	52.4	47.7	43	71	41.8	37.3	31	65
21.	39.0	35.2	29	69	49.5	40.7	27	43	40.1	35.8	28	65
22.	44.8	39.8	33	64	55.8	44.6	31	38	47.2	40.8	31	56
23.	45.3	42.3	39	78	49.8	46.7	44	79	45.4	42.9	40	82
24.	39.8	37.0	33	78	46.9	40.8	33	58	43.6	39.0	33	66
25.	38.8	37.3	35	88	51.8	44.8	36	56	47.8	42.1	36	62
26.	39.0	38.5	38	96	47.2	43.4	39	74	44.3	42.8	41	88
27.	41.7	41.3	41	97	46.1	44.	43	87	44.0	41.2	37	79
28.	35.7	34.0	32	84	52.5	46.1	39	61	39.9	37.8	35	83
29.	32.3	31.0	28	87	44.0	40.0	35	70	42.2	40.8	39	89
30.	36.3	35.5	34	93	46.8	41.6	35	64	41.8	38.0	33	71
31.	32.3	31.5	29	92	43.5	38.0	29	58	41.0	37.0	31	68
Means.				83				64				77
Mean for month.								75				

HYGROMETER NO. 3.—IN FOREST.

October, 1892.

Day.	7 A. M.				1 P. M.				7 P. M.			
	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.
	°	°	°	°	°	°	°	°	°	°	°	°
1.	52.2	47.4	42	70	50.5	44.8	38	63	43.2	38.3	31	62
2.	40.1	36.9	33	74	47.7	42.8	37	67	44.0	40.8	37	76
3.	30.2	29.3	27	90	46.2	43.0	40	77	43.4	42.9	42	96
4.	46.8	46.0	44	94	50.0	49.1	48	94	48.7	48.0	48	95
5.	38.5	38.5	38.5	100	48.0	45.7	43	84	46.5	44.5	42	85
6.	41.1	39.2	36	85	47.8	44.3	41	76	45.0	42.4	40	81
7.	45.2	42.8	40	83	57.0	53.6	51	81	50.3	48.8	49	97
8.	46.5	44.6	42	86	62.0	58.5	56	81	58.0	55.0	53	83
9.	50.2	50.2	50.2	100	46.3	45.3	44	93	43.8	42.8	42	92
10.	32.0	31.9	30	99	46.8	43.0	39	74	47.8	44.0	40	74
11.	40.5	37.8	35	78	48.0	44.4	41	75	40.0	37.8	35	82
12.	30.6	29.5	28	89	48.1	44.9	42	78	46.0	43.0	40	79
13.	29.0	27.8	26	87	41.0	40.7	40	98	47.2	47.0	46	99
14.	51.8	51.5	51	98	65.2	60.5	58	66	56.8	53.8	52	83
15.	39.0	37.8	37	90	55.0	52.1	50	83	50.7	48.6	47	86
16.	50.9	50.5	50	98	52.4	52.2	51	99	52.2	52.0	51	99
17.	40.4	38.9	36	88	46.3	43.1	39	77	39.2	38.8	38	97
18.	27.3	27.0	25	96	47.4	44.8	42	81	41.7	40.5	40	90
19.	48.8	48.2	48	96	51.8	50.9	50	95	51.2	50.8	50	98
20.	41.7	40.2	39	88	53.4	47.0	39	62	41.9	39.4	36	81
21.	36.8	35.4	33	88	48.0	44.5	41	76	41.0	37.7	33	74
22.	42.6	40.4	39	83	49.8	44.7	40	67	48.6	43.0	37	62
23.	41.7	40.6	40	91	49.0	46.0	43	80	46.4	43.8	41	81
24.	39.5	37.4	34	82	45.8	41.9	37	73	45.0	41.2	36	73
25.	37.0	35.8	35	89	49.8	45.1	41	69	48.8	44.0	38	68
26.	39.0	37.8	37	90	46.0	44.0	42	85	44.7	43.1	42	88
27.	41.0	40.0	39	92	44.8	44.0	42	94	46.0	45.0	44	93
28.	38.0	36.5	34	87	45.0	42.3	40	80	42.2	40.7	39	88
29.	30.8	29.8	28	90	42.0	40.8	40	90	40.6	39.8	39	94
30.	35.7	35.7	35.7	100	45.0	41.3	37	75	41.5	38.4	35	76
31.	31.3	30.0	26	86	41.3	38.0	33	74	41.0	38.8	38	91
Means.				90				80				85
Mean for month.								83				

HYGROMETER NO. 4.—IN FOREST.

OCTOBER, 1892.

Day.	7 A. M.				1 P. M.				7 P. M.			
	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.	Dry Bulb.	Wet Bulb.	Dew Point.	Humidity.
	°	°	°	°	°	°	°	°	°	°	°	°
1.	52.0	46.3	41	65	50.6	44.2	37	60	42.9	38.0	31	63
2.	40.8	37.0	31	70	47.5	41.0	31	55	43.2	39.8	35	75
3.	30.3	29.5	27	91	46.2	42.9	39	77	43.1	42.6	42	96
4.	46.8	46.5	46	98	49.6	49.0	48	96	49.2	48.8	48	98
5.	36.3	36.3	36.3	100	47.8	45.7	44	85	46.0	44.0	42	85
6.	41.0	39.1	36	85	47.3	43.8	40	76	45.0	43.5	42	89
7.	43.8	42.2	41	87	57.0	53.0	50	77	50.5	48.1	45	84
8.	45.3	44.2	43	91	62.4	59.3	57	83	56.0	54.7	54	92
9.	50.4	50.4	50.4	100	45.4	45.0	44	97	42.5	42.0	41	96
10.	31.7	31.6	30	99	46.4	41.9	36	68	47.2	43.5	40	74
11.	40.0	37.0	33	76	47.4	44.2	41	78	39.5	38.8	38	94
12.	29.9	29.1	27	91	47.5	43.9	41	75	44.0	41.4	38	80
13.	30.0	28.8	27	87	40.5	40.1	39	97	48.0	47.6	47	97
14.	49.5	49.3	49	99	64.0	58.3	55	71	53.4	51.0	48	85
15.	38.8	38.0	37	94	55.8	51.9	49	78	49.2	46.8	44	84
16.	52.0	50.3	49	89	52.6	52.3	52	99	52.4	52.2	51	99
17.	40.1	38.8	35	85	46.4	42.5	37	73	37.5	36.8	36	94
18.	27.3	27.1	25	98	47.5	43.6	40	74	41.4	40.3	39	91
19.	48.5	48.0	47	96	52.0	51.2	50	95	51.2	51.0	50	99
20.	40.2	40.0	39	98	49.6	45.3	41	72	41.5	39.5	36	84
21.	37.2	35.3	33	88	46.4	42.1	36	70	40.6	37.8	34	78
22.	42.8	40.5	38	83	53.1	44.9	36	51	49.0	44.1	38	68
23.	42.5	40.7	39	86	49.3	48.3	47	93	45.6	43.8	42	87
24.	39.4	37.7	35	86	45.7	41.6	37	71	45.0	41.5	37	75
25.	35.0	34.5	33	95	50.0	44.9	40	67	47.4	44.2	41	78
26.	38.8	37.8	36	92	45.5	43.8	43	87	44.3	43.2	42	91
27.	40.6	40.0	40	95	44.5	43.8	43	94	43.3	43.0	42	98
28.	37.0	36.5	36	96	45.8	43.3	41	82	41.0	39.9	39	91
29.	30.7	30.3	29	96	41.8	40.0	38	86	40.8	40.1	40	94
30.	35.7	35.7	35.7	100	44.3	41.0	36	76	41.2	38.8	35	91
31.	31.3	30.5	28	92	41.0	38.0	34	76	40.7	38.0	35	78
Means.				91				79				86
Mean for month.								85				

SOIL THERMOMETERS.—October, 1892.

Day.	1 inch.			3 inches.			6 inches.			9 inches.			12 inches.			24 inches.			36 inches.		
	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.	7 A.M.	1 P.M.	7 P.M.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1	53.7	53.0	50.5	54.0	53.5	51.2	54.6	54.0	53.3	54.0	53.8	53.5	54.5	54.5	54.3	55.6	55.6	55.5	56.2	56.0	55.8
2	46.8	48.0	48.0	46.4	48.0	48.0	50.5	49.8	49.8	50.8	50.0	50.0	52.7	51.9	51.6	55.4	55.3	55.0	55.7	55.7	55.5
3	44.0	47.5	47.5	43.5	47.7	47.0	47.9	48.1	48.5	48.4	48.0	48.5	50.5	49.9	50.0	54.6	54.5	54.2	55.4	55.4	55.3
4	48.0	49.4	49.0	48.3	49.4	50.0	49.0	49.5	50.1	48.9	49.0	49.5	50.0	50.2	50.4	53.8	53.7	53.6	54.9	54.9	54.8
5	46.5	48.4	48.5	47.6	48.4	48.5	49.4	49.0	49.3	49.2	48.7	49.0	50.5	50.1	50.0	53.4	53.3	53.2	54.5	54.4	54.4
6	45.8	47.0	47.0	46.4	47.6	47.5	48.4	48.2	48.3	48.2	48.0	48.0	49.8	49.4	49.4	53.0	53.0	52.8	54.0	54.0	53.9
7	45.2	49.4	49.6	45.5	49.0	49.6	47.2	47.9	48.2	47.1	47.4	47.5	48.8	48.6	49.0	52.5	52.5	52.3	53.8	53.7	53.5
8	47.0	53.0	53.3	48.0	32.0	38.0	49.0	50.0	51.4	48.8	49.2	50.5	49.6	49.8	50.5	52.2	52.3	52.2	53.4	53.5	53.4
9	51.5	50.5	50.0	51.5	50.6	50.2	51.6	51.4	51.0	50.3	51.1	51.0	51.5	51.5	51.5	52.4	52.4	52.4	53.8	53.2	53.0
10	44.8	44.9	48.2	45.5	46.5	48.2	48.6	48.0	48.5	48.7	48.6	48.4	50.2	49.4	49.4	52.4	52.5	52.3	53.0	52.5	53.0
11	45.9	45.9	46.2	46.1	46.7	46.4	47.8	47.8	48.0	47.7	48.0	48.0	49.0	49.4	49.8	50.0	51.7	51.8	52.8	52.6	52.8
12	42.2	47.0	45.8	39.4	47.0	45.5	46.0	47.6	46.4	46.2	47.5	46.2	48.0	48.7	47.4	51.5	51.9	51.5	52.5	52.8	52.5
13	40.7	42.6	45.0	41.3	42.8	44.9	44.3	44.3	45.4	45.0	44.3	45.1	45.8	46.2	46.8	51.0	50.8	50.8	52.3	52.2	52.3
14	45.0	49.0	50.0	45.0	48.5	49.7	46.0	46.9	48.7	45.5	46.1	47.8	46.5	46.9	47.7	50.4	50.4	50.4	52.0	51.8	52.0
15	45.0	49.5	49.6	45.0	47.4	49.0	47.5	47.5	48.8	47.5	47.3	48.2	48.4	48.0	48.4	50.4	50.5	50.4	51.5	52.1	51.7
16	48.4	49.5	50.3	48.4	49.5	50.0	48.5	49.2	49.4	48.3	48.5	48.9	49.0	49.0	49.3	50.5	50.5	50.7	51.5	51.5	51.5
17	47.4	47.5	47.0	47.5	47.4	46.9	49.4	48.5	48.6	49.2	48.5	48.5	49.7	49.4	49.7	50.5	50.6	50.8	51.5	51.3	51.5
18	42.2	46.0	46.1	42.7	45.1	46.1	46.2	45.6	46.8	46.5	45.7	46.6	48.0	47.4	47.5	50.6	50.6	50.5	51.5	51.5	51.5
19	46.1	48.0	48.8	46.3	47.9	48.6	46.8	47.5	48.2	46.6	47.0	47.5	47.5	49.6	48.1	50.2	50.1	50.3	51.3	51.3	51.4
20	45.4	47.0	46.0	45.7	45.9	45.9	47.3	46.9	47.3	47.1	46.7	47.1	48.0	47.8	47.8	50.0	50.0	49.9	51.0	51.0	51.0
21	42.2	44.2	43.5	41.4	44.2	43.8	45.4	45.1	45.4	45.4	44.8	45.2	46.9	46.2	46.1	50.1	49.8	49.6	51.0	50.7	50.7
22	42.4	44.8	45.2	42.7	44.4	45.0	44.7	44.5	45.3	44.4	44.3	45.1	45.8	45.6	46.0	49.7	49.5	49.4	50.7	50.7	50.7
23	41.1	44.0	44.3	41.5	43.0	44.3	44.0	44.0	44.7	44.0	43.7	44.2	45.5	45.0	45.3	49.2	49.0	48.9	50.1	50.4	50.4
24	42.4	43.4	44.0	42.7	43.5	44.0	44.3	43.1	44.5	44.0	43.8	44.2	45.4	45.0	45.0	48.8	48.6	48.5	50.2	50.0	50.0
25	42.0	44.0	45.0	42.0	44.2	44.0	44.0	44.0	44.8	44.0	43.6	44.2	45.0	44.9	45.0	48.5	48.5	48.4	49.8	49.8	49.8
26	42.7	44.6	45.0	42.0	44.5	45.0	44.5	44.5	45.0	44.3	44.4	44.5	45.2	45.1	45.4	48.3	48.3	48.3	49.7	49.6	49.8
27	44.0	45.0	46.0	43.0	46.0	46.3	45.0	45.2	44.6	44.8	44.6	45.0	45.7	45.5	45.6	48.7	48.1	48.2	49.5	49.5	49.5
28	43.5	45.5	45.5	42.5	45.7	45.0	45.0	44.9	45.8	45.0	44.5	45.2	45.7	45.5	45.7	48.2	48.2	48.2	49.5	49.3	49.4
39	41.0	44.0	43.6	40.5	43.4	43.5	44.8	43.6	44.2	44.2	43.5	44.0	45.5	45.0	45.5	48.0	47.0	48.2	49.2	49.2	49.3
30	40.4	42.5	42.5	40.5	42.5	42.5	43.0	43.0	43.2	44.2	43.0	43.2	44.6	44.1	44.1	47.9	47.9	47.9	49.0	49.0	49.0
21	39.5	40.8	41.5	39.8	41.0	41.8	42.4	41.9	42.4	42.4	41.6	42.0	43.7	43.2	43.2	47.5	47.5	47.3	48.9	48.7	48.7
Means	44.61	46.64	46.85	44.60	46.56	46.82	46.87	46.82	47.20	46.80	46.62	46.34	47.97	47.83	47.85	50.82	50.80	50.76	51.93	51.88	51.87

OCTOBER, 1892.

	Maximum and Minimum Thermometers.		Terrestrial Radiation and Sun Thermometer.		Sunshine.	Precipitation.			Wind. Anemometer observed at 1 P.M. daily.		
Day.	Maximum.	Minimum.	Terrestrial Radiation.	Sun Thermometer.	Hours of Sunshine.	Time of beginning.	Time of ending.	Amount of rain in inches.	Reading.	Number of miles in last twenty-four hours.	Average rate per hour.
	°	°	°	°							
1	54.1	43.2	33.6	120 0	8.5				141.2	436.4	18.18
2	50.5	33.0	28.6	110.2	8				550.8	409.6	17.07
3	49.5	24.8	17.5	98.2	2	2 P.M.			638.3	87.5	3.65
4	52.5	42.0	39.0	76.1	0		6 P.M.	.46	757.4	119.1	4 96
5	51.2	33.7	27.7	111.5	2				888.0	130.6	5.44
6	51.4	35.4	30.4	100.0	2				223.2	325.2	13.55
7	61.2	35.7	30.0	110.5	0				509.8	286.6	11.94
8	68.5	42.5	37.0	117.5	8	9 P.M.			641.3	131.5	5.48
9	58.2	39.8	38.2	64.5	0.5		10.30 A.M.	.30	791.2	149.9	6 25
10	54.8	28 4	22.6	111.1	10				913.5	122.3	5.10
11	50.1	36.8	26.0	117 9	9.5				71.8	148.3	6.18
12	52.6	25.8	18.0	108.7	11				283.5	211.7	8.28
13	50.0	23.5	16.5	68.2	0.5				333.5	50.0	2.08
14	67.2	45.0	37.3	113.0	7				508.3	174.8	7.28
15	60.2	31.3	23 8	112.8	10				678.0	169.7	7.07
16	54.1	44.7	39.8	56.0	0				876.7	198.7	8.28
17	50.1	36.6	25.5	108.3	8.5				151.8	265.1	10.05
18	54.9	22.7	17.2	117.4	6				246.5	94.7	3.95
19	53.0	38.1	32.2	55.0	0	10 A.M.	4 P.M.	.07	387.1	140.6	5.86
20	54.0	38.9	30.0	108.5	8				590.5	203.4	8.48
21	51.1	33.3	23.5	102.0	7.5				8·5.8	305.3	12.68
22	56.2	33.0	31.8	102.6	10.5				294.5	388.7	16.20
23	51.2	31.3	22.2	105.0	2.5	10.40 A.M.	1.30 P.M.	.06	455.2	160.7	6.70
24	49.0	37.8	32.6	96.4	3				758.3	303.1	12.63
25	53.1	35.3	25.8	102.2	4				88.9	270.6	11.28
26	47.2	34.0	25.8	60.0	0				189.8	100.9	4.20
27	50.8	38.5	33.0	100.0	0.5				218.5	78.7	3.28
28	52.6	35.7	28.6	106.7	7				231.0	62.5	2.60
29	46.8	27.3	22.0	101.8	3	2 P.M.	Night	.57	342.5	61.5	2.56
30	48.6	32 5	29.5	108.8	7				661.8	319.3	13.30
31	45.4	28.8	22.8	67.4	2.5				927.8	266.0	11.08
				Total	149		Total	146	Total	6173.0	
Means	53.16	34.47	28.02	97.62	4.8					199.13	8.26

MAINE AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 4.

SECOND SERIES.

TESTING CREAM AND MILK FAT TEST AND LACTOMETER.

J. M. BARTLETT.

NOTES ON TESTING CREAM.

As many creameries are adopting the fat test as a measure by which to pay for their cream, it is of the utmost importance that the samples for the test should be properly taken. Cream from a herd of several cows raised at the proper temperature and skimmed in a proper manner will not vary much in butter fat from day to day, but all patrons are not sufficiently careful in skimming and handling their cream so that it is subject to no small amount of variation, causing the creamery man considerable trouble.

The skimming should never be done by dipping the cream from the top of the milk, as this method always involves a loss of both cream and skimmed milk. The loss of cream is from its being mixed with the milk by the dipping and the loss of milk to the farmer is by a large amount being taken up with the cream in an effort to secure all the cream. This milk is taken to the factory and is a total loss to the farmer. The skimming should be done as cleanly as possible and this is best accomplished by a faucet near the bottom of the can. The next best thing is a syphon by means of which the milk or cream can be drawn off separately.

The above mentioned difficulties to the creamery managers, however, can be wholly overcome by the composite sample, first recommended for milk by Prof. Patrick, of the Iowa Experiment Station. There are several ways of taking this sample. One is to provide the collector with a measuring can and a small can marked with the patron's name or number in which to put the sample. The cream is measured, then thoroughly mixed and a portion taken out, put in the sample can and sealed. The amount taken should be an aliquot part of the whole.

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ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

FOR THE

YEAR 1893.

PART II.

PART I–Reports of Trustees, President and Treasurer.

PART II–Report of the Director of the Agricultural Experiment Station.

ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

FOR THE

YEAR 1893.

PART II.

Report of the Director of the Agricultural Experiment Station.

AUGUSTA:
BURLEIGH & FLYNT, PRINTERS TO THE STATE.
1894.

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The Station

MAINE STATE COLLEGE.

AGRICULTURAL EXPERIMENT STATION.

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The President.

WHITMAN H. JORDAN, M. S.	Director.
*MERRITT C. FERNALD, Ph.D	Meteorologist.
WALTER BALENTINE, M. S	Agriculturist.
JAMES M. BARTLETT, M. S	Chemist.
FRANCIS L. HARVEY, Ph.D.	Botanist and Entomologist.
LUCIUS H. MERRILL, B. S	Chemist.
FREMONT L. RUSSELL, V. S	Veterinarian.
WELTON M. MUNSON, M. S	Horticulturist.
FRED P. BRIGGS, B. S	Assistant in Botany and Entomology.
HARRIS P. GOULD	Assistant in Horticulture.
ANDREW M. SHAW	Foreman in Experimental Agriculture.
Mrs. J. HAMLIN WAITT	Clerk and Stenographer.

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*Resigned September 1, 1893.

TREASURER'S REPORT.

The Maine Agricultural Experiment Station in account with the United States appropriation:

RECEIPTS.

From the Treasurer of the United States as per appropriation for the year ending June 30, 1893	$15,000 00

EXPENDITURES.

Botany and Entomology	$ 14 87	
Chemical Laboratory	281 47	
Expense Account	160 89	
Field and Feeding	1,253 61	
Fertilizer Inspection	134 80	
Horticultural Department	689 56	
Meteorology	30 70	
Printing	1,458 79	
Construction and Repairs	186 04	
Stationery and Postage	93 95	
Traveling Expenses	135 35	
Library	120 85	
Veterinary Science	5 40	
Fuel	140 82	
World's Fair	501 87	
Trustee Expenses	16 00	
Water Supply	200 00	
Salaries	9,574 97	
		$14,999 94

I hereby certify that the above is a correct statement of the amount expended by the Maine Experiment Station for the year ending June 30, 1893.

G. H. HAMLIN, TREASURER,

Trustees of Maine State College of Agr. and the Mech. Arts.

I hereby certify that I have examined the accounts of the Maine Experiment Station for the fiscal year ending June 30, 1893; that I have found the above to be a correct statement of expenditures both as to amount and classification, for all of which, proper vouchers are on file.

HENRY LORD, AUDITOR,

Trustees of Maine State College of Agr. and the Mech. Arts.

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DIRECTOR'S REPORT.

A. W. Harris, Ph. D., President Maine State College.

SIR:—I submit herewith a report of the work performed in the various departments of the Experiment Station for the year 1893:

It is hoped that the facts and discussions therein presented will prove of value to the agriculture of the State, through a careful consideration of their relations to farm practice.

The past year has been one of general prosperity in the affairs of the Station. In one direction, at least, as will be seen by subsequent statements, an addition of equipment and enlargement of work have been made which give promise of results of great value. Better than anything else which could be mentioned, perhaps, is the increasing evidence that the Station is exerting a positively helpful influence in the agricultural affairs of Maine. The large correspondence which has grown up between the Station officers and the farmer citizens of the State, the numerous appeals for aid in various directions and the cordial and sympathetic reception which representatives of the Station receive at farmers' institutes and other public meetings may not only constitute substantial reasons for encouragement, but may also convey to each member of the Station staff a sense of personal gratification. I wish to express in behalf of myself and my associates a grateful appreciation of the pleasant relations which we have come to sustain toward a large number of leading Maine farmers, and of the cordial co-operation of the Board of Agriculture, the State Pomological Society and the Patrons of Husbandry.

FERTILIZER INSPECTION.

The Maine legislature of 1893 enacted a new law for the control of the sale and inspection of commercial fertilizers, of which the Director of this Station is made the executive officer. This work will necessarily and properly be done at the Station.

It is provided that an analysis fee of fifteen dollars shall be paid by the manufacturers, importers or dealers for each distinct brand of fertilizer of which more than thirty tons are sold in Maine, the income thus derived to be used to pay the expenses of the fertilizer inspection and publishing the results. It is even now very evident that this fee is too small. In fact, the experience of ten or twelve years had previously shown that a fee of at least $20 would be needed. It is hoped that the legislature of 1895 will remedy this error by increasing the fee.

THE NEW FORCING HOUSE.

The most notable addition to the Station equipment is the new forcing house, now nearing completion, which is to be used in the study of problems in plant nutrition. The work is to be under the immediate charge of Professor Balentine, who reports on subsequent pages the results of experiments made in the forcing house erected several years since. It is believed that in giving more attention to a scientific study of certain phases of plant nutrition the Station will occupy a field very largely neglected by American experiment stations, this line of study having so far held a place much subordinate to animal nutrition. The new house is 65x18 feet. and is to be equipped in a manner best adapted to its intended purpose.

INCREASE OF MAILING LIST.

At a meeting of the Station Council in the autumn of 1892, it was urged that the list of farmers receiving the publications of the Station should be increased. This matter was left with me for action. After considering several plans, I decided to send to each postmaster in the State a card-board poster showing a cut of the College buildings, and stating thereon that the station publications would be sent free to any Maine farmer requesting them. Through such advertising and by other means that have been adopted, the mailing list of residents of this State has been increased over two thousand names, so that now it numbers between seven and eight thousand. It is doubtful if a larger proportion of the farmers of any state are receiving the bulletins of their experiment station than is the case in Maine. During the year the mailing list has also been revised by sending to each postmaster for correction a list of names previously addressed to his office. In this way a large number of errors were corrected.

STATION PUBLICATIONS.

The large increase that has been made to the mailing list has rendered it necessary to consider the most economical methods of preparing and distributing Station publications. It is very desirable, also, that the manner of presenting the results of experiments and investigations shall be such as to secure for them wide attention. Experience has shown that in order to accomplish this, the statements made by Station officers must be as concise and simple as is consistent with accuracy. On the other hand, it is very important that a certain class of readers, such as other station workers and the farmers who possess scientific knowledge and training, shall have access to a full record of the data upon which are based the conclusions that stand in close relation to farm practice. In view of the foregoing considerations, it has been decided to issue numerous short bulletins, of not over four pages each, which shall be sent to the entire mailing list, and which shall present to the reader, in a form adapted to the unscientific public, all the results of Station work which have an immediate relation to farm practice. There will also be issued an annual report which shall contain a complete record of the doings of the Station, stated in part at least, in a somewhat scientific and technical form. It is proposed that this annual report shall have a circulation limited to the officers and staffs of other stations, certain exchange publications and such farmers as shall specially request that it be sent to them.

ACKNOWLEDGMENTS.

I append a statement of gifts made to the Station, and publications received by the Station free of charge. I wish to make our acknowledgment for these favors.

W. H. JORDAN, *Director*.

MAINE STATE COLLEGE,
ORONO, ME., Dec. 31, 1893.

Donations to the Horticultural Department, 1893.

J. M. Thorburn & Co., New York, N. Y., vegetable seeds.

W. Attle Burpee, Philadelphia, Pa., miscellaneous vegetable and flower seeds.

J. J. H. Gregory & Son, Marblehead, Mass., vegetable seeds.

U. S. Department of Agriculture, Washington, D. C., vegetable seeds, cions, cuttings.

Cornell University, Ithaca, N. Y., cuttings of Russian willows and poplars.

A. M. Smith, St. Catherines, Ontario, six plants Pearl gooseberry.

H. S. Anderson, Union Springs, N. Y., three plants Frontenac gooseberry.

Benjamin F. Sill, Long Island City, N. Y., one rubber plant sprinkler.

Gould's Manufacturing Co., Seneca Falls, N. Y., one Knapsack spraying pump.

The following newspapers and other publications are kindly donated to the Station by the publishers during 1893-4:

Farmers' Home, Dayton, Ohio.
Holstein Friesian Register, Boston, Mass.
Farm and Home, Springfield, Mass.
Jersey Bulletin, Indianapolis, Ind.
Monthly Bulletin, Philadelphia, Pa.
Farmers' Advocate, London, Ont.
Maine Farmer, Augusta, Maine.
Southern Cultivator, Atlanta, Ga.
American Dairyman, New York, N. Y.
The Sun, Baltimore, Md.
Massachusetts Ploughman, Boston, Mass.
Practical Farmer, Philadelphia, Pa.

New England Farmer, Boston, Mass.
Louisiana Planter, New Orleans, La.
Mirror and Farmer, Manchester, N. H.
Texas Farmer, Dallas, Texas.
Hoard's Dairyman, Fort Atkinson, Wis.
Iowa Farmer and Breeder, Cedar Rapids, Iowa.
Detroit Free Press, Detroit, Mich.
Orange County Farmer, Port Jervis, N. Y.
Farm Journal, Philadelphia, Pa.
Delaware Farm and Home, Wilmington, Del.
The Western Rural, Chicago, Ill.
American Cultivator, Boston, Mass.
Farmers' Review, Chicago, Ill.
The Rural Canadian, Toronto, Ont.
Vick's Magazine, Rochester, N. Y.
The Farm and Dairy, Ames, Iowa.
The Clover Leaf, South Bend, Ind.
New York World. (Weekly.)
The Grange Visitor, Lansing, Mich.
The Industrial American, Lexington, Ky.
The American Grange Bulletin and Scientific Farmer, Cincinnati, Ohio.
Agricultural Epitomist, Indianapolis, Ind.
The Prairie Farmer, Chicago, Ill.
Northern Leader, Fort Fairfield, Me.
Farm Life, Rochester, N. Y.
American Agriculturist, New York.
American Creamery, Chicago, Ill.

Investigation on the Foraging Powers of Some Agricultural Plants for Phosphoric Acid.

WALTER BALENTINE.

Of recent investigations in plant nutrition those establishing the fact that leguminous plants are able to gather a portion of their nitrogen either directly or indirectly from the free nitrogen of the air are by far the most important, both from the scientific and the practical stand points.

These investigations settle a question that has attracted the attention of agricultural chemists for half a century. On the practical side the results enable us to say, that it is possible, by growing and feeding to farm animals such plants as peas and clover, to increase the stock of nitrogen for manurial purposes without resorting to the various expensive commercial nitrogenous materials.

Stating the results of these investigations concisely, it has been found that the leguminous plants are able to forage on the atmosphere for a portion of their nitrogen. Other plants either possess this power to a much less degree or not at all. If we look for a reason why this family of plants has attracted so much attention from scientists we find it in the fact that some of its members, the clovers especially, have been found in practical farming to be plants which by their growth on the soil, apparently leave it richer in plant food than before, and that farmers are actually able to produce more of grass, grain and potatoes when clover is used as one of the crops in rotation. It was to learn why a plant that takes up such large quantities of nitrogen as clover, should still leave the ground in a better condition for succeeding crops, that the sources of supply of nitrogen to the leguminous plants have been so carefully studied.

The value of the results of this work to the agriculture of the world cannot be over-estimated. There are, however, other problems in plant nutrition which deserve as careful study as the nitrogen question and which may yield results of equal practical importance.

All who have given especial attention to the subject of plant nutrition will, undoubtedly, agree that the foraging powers of plants for the elements contained in the ash, vary greatly. This fact is recognized by the majority of observing farmers, as is shown by the following common sayings: Wheat requires a rich soil." "Corn is a grass feeder." "Oats are an exhaustive crop."

Notwithstanding that these views regarding the variation in foraging powers of different crops have been held by many for years, no one is prepared to say just how it is exerted. We are hardly ready to express an opinion whether the greater vigor of certain plants as compared to other species grown on the same soil is due to their superior foraging powers for all of the elements contained in their ash, or for one or more particular elements.

It seems quite as likely, however, that some plants are able to use certain soil compounds of potash or phosphoric acid, which are not available to other plants, as it did that the legumes were able to obtain nitrogen from sources that were not available to the grasses.

Believing that a study of the foraging powers of different agricultural plants would reveal facts of scientific interest, and at the same time of practical value to agriculture, the writer commenced a series of experiments, in the fall of 1892, designed to test the readiness with which different plants obtain their phosphoric acid from insoluble phosphates.

The reason why phosphoric acid was selected on which to make these first studies, in preference to any other substance was, that in practical manuring with crude phosphates, and also in their use in experimental work, different crops had apparently showed decided differences in their abilities to gather phosphoric acid from such a source.

EXPERIMENTAL METHODS.

In order to have the work as much as possible under control the experiments were conducted in boxes in the college forcing house. These boxes were of wood, fifteen inches square and twelve inches deep. For soil a fine sand was used, taken from a sand bank about three feet below the surface. This sand was drawn to the forcing house, screened and thoroughly mixed by repeatedly shoveling it over, after which a sample was taken and the content of potash and phosphoric acid determined, with the following result: Potash, 0.096 per cent; phosphoric acid, 0.012 per cent.

One hundred and twenty pounds of sand were used in each box.

For each kind of plant studied nine boxes were used, in three sets of three boxes each.

The three boxes of each set received the following manuring per box:

SET I
- 8.5 grams nitrate of soda = 1.36 grams nitrogen.
- 2.6 grams muriate of potash = 1.36 grams potash.

SET II
- 8.5 grams nitrate of soda = 1.36 grams nitrogen.
- 2.6 grams muriate of potash = 1.36 grams potash.
- 17.0 grams South Carolina rock =
  - 3.96 grams insoluble phosphoric acid.
  - 0.39 grams citrate soluble phosphoric acid.

SET III
- 8.5 grams nitrate of soda = 1.36 grams nitrogen.
- 2.6 grams muriate of potash = 1.36 grams potash.
- 28.5 grams acidulated South Carolina rock =
  - 3.34 grams soluble phosphoric acid.
  - 0.50 grams citrate soluble phosphoric acid.
  - 0.62 grams insoluble phosphoric acid.

It will be seen that all of the boxes were treated alike with reference to potash and nitrogen, that the plants grown in Set I were dependent on the phosphoric acid originally in the sand, that those grown in Set II had in addition 4.32 grams of phosphoric acid, mostly insoluble, supplied by crude finely ground South Carolina rock, and that those grown in the boxes of Set III had in addition to that originally contained in the sand 4.46 grams of phosphoric acid, mostly soluble, supplied in acidulated South Carolina rock.

The plants thus far studied have been wheat, barley, corn, beans, peas, potatoes and turnips.

Wheat was planted in the boxes of Set I A, Set II A and III A.
Barley " " Set I B, Set II B and III B.
Corn " " Set I C, Set II C and III C.
Beans " " Set I D, Set II D and III D.
Peas " " Set I E, Set II E and III E.
Potatoes " " Set I F, Set II F and III F.
Turnips " " Set I G, Set II G and III G.

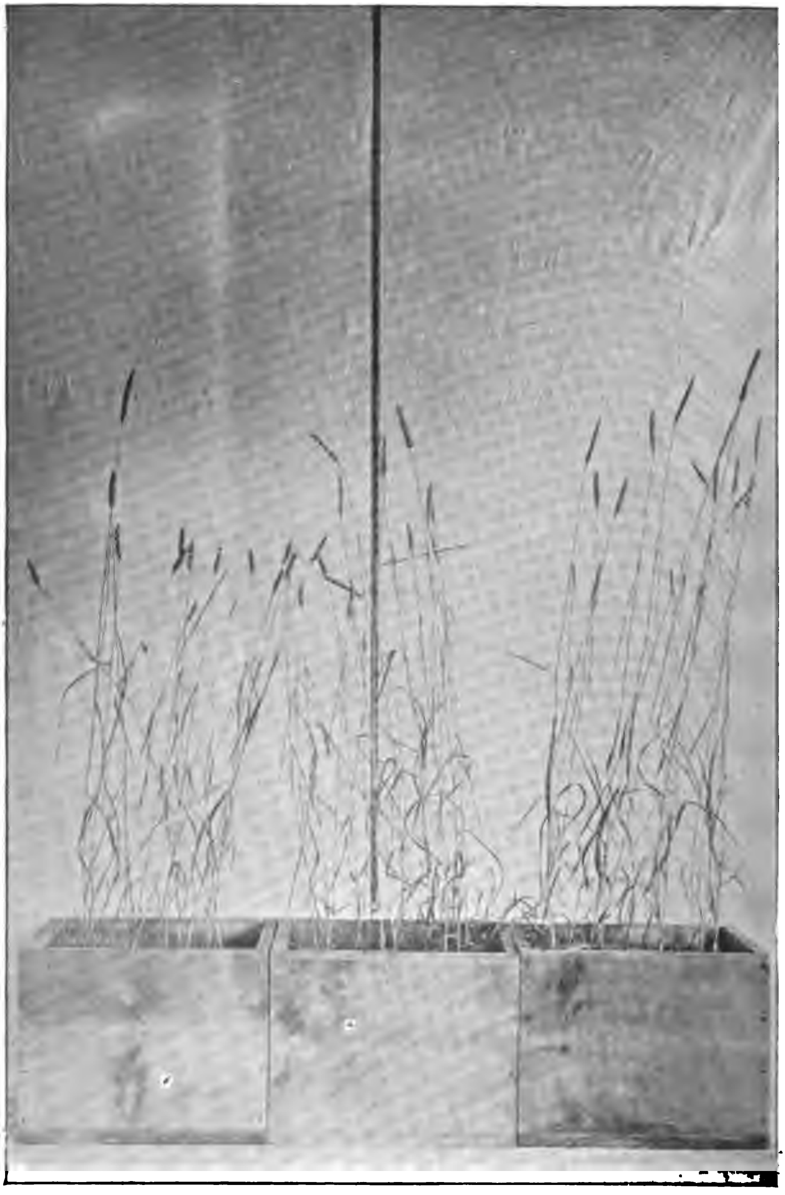
After planting, the boxes were under the care of a man experienced in growing plants under glass. Water was supplied as it was believed to be needed. At the proper time the plants were thinned so that the boxes having the same kind of plants contained the same number of plants to the box.

The plants were allowed to grow to maturity. Immediately before harvesting, the crops were photographed and plates made showing the relative development of the plants produced. At the time of harvesting, the crops of wheat, barley, corn, peas and beans produced in each box were weighed separately in an air dry condition, after which the amount of dry matter was determined in the combined crop of the three boxes of each set. In the combined crop of each set the nitrogen was determined as well as the phosphoric acid, potash and other mineral matters.

With the pototoes and turnips the crops were weighed fresh at harvesting. In other respects these crops were treated like the others.

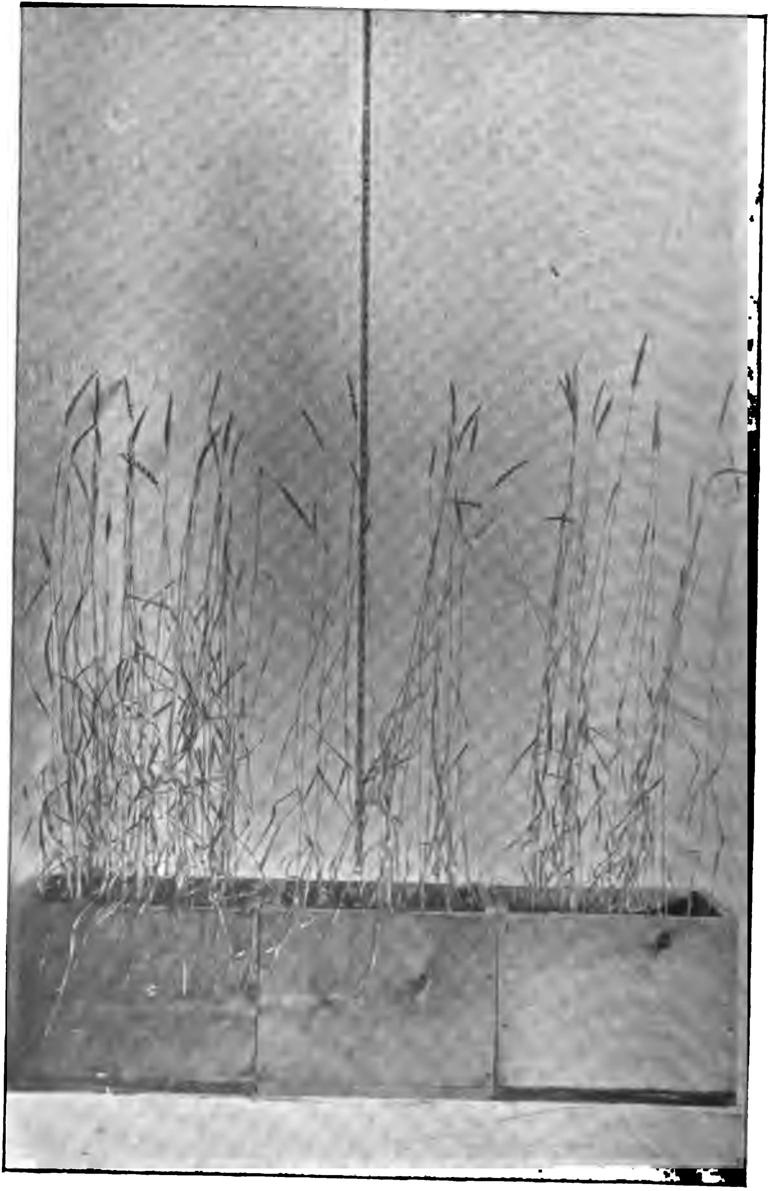
The results of this investigation are shown in the following tables with the accompanying plates:

PLATE I. A.



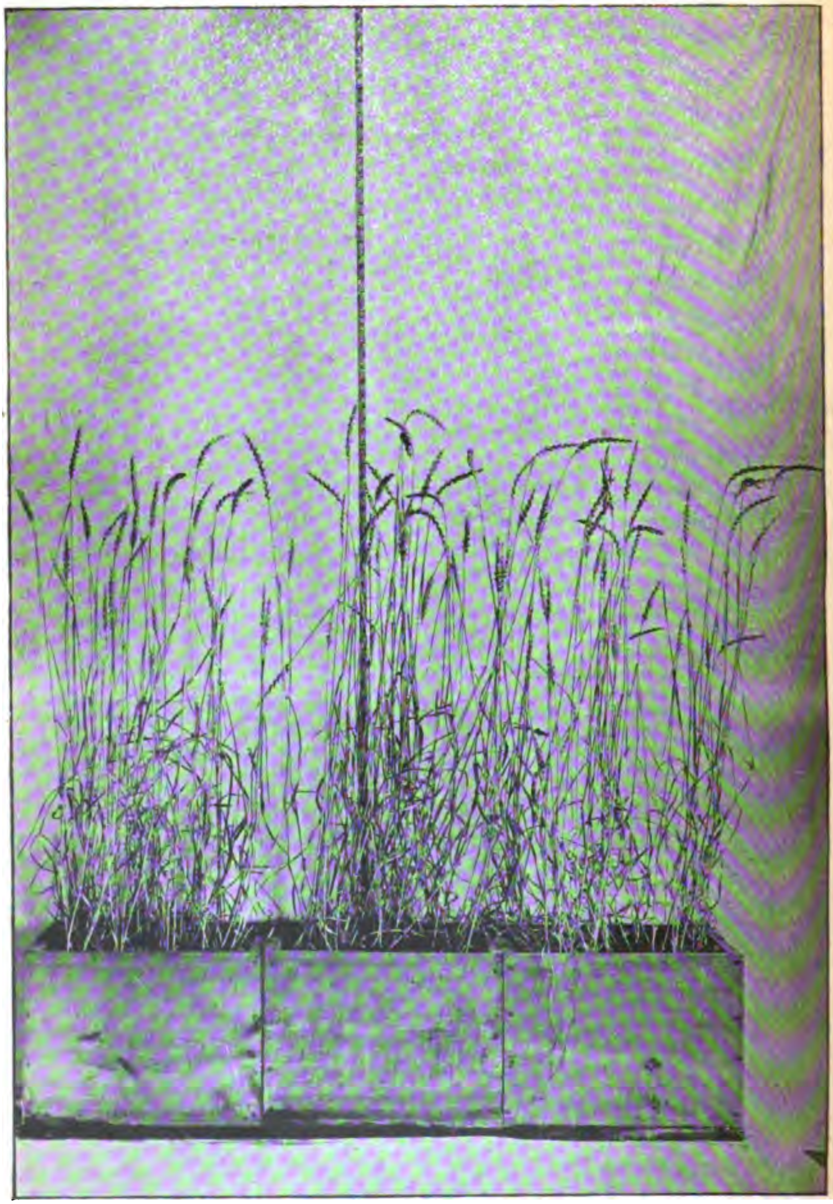
CROP, WHEAT.

Manure. -- Nitrate of Soda, Muriate of Potash.



CROP, WHEAT.

Manure, — Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.



CROP, WHEAT.

Manure, — Nitrate of Soda, Muriate of Potash. Acidulated S. C. Rock Phosphate.

TABLE I.

EXPERIMENT WITH WHEAT.

Set.	Manure per box.	No. of box.	Total crop.	Grain.
I A..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	22 grams	7 grams
		2	26 grams	8 grams
		3	36 grams	11 grams
		Total..	84 grams	26 grams
II A..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and crude South Carolina rock, 17 grams.	1	46 grams	15 grams
		2	79 grams	24 grams
		3	37 grams	11 grams
		Total..	162 grams	50 grams
III A..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	103 grams	32 grams
		2	92 grams	30 grams
		3	130 grams	43 grams
		Total..	325 grams	105 grams

Dry matter.

Set I A	76.9 grams
Set II A	148.6 grams
Set III A	296.3 grams

TABLE II.

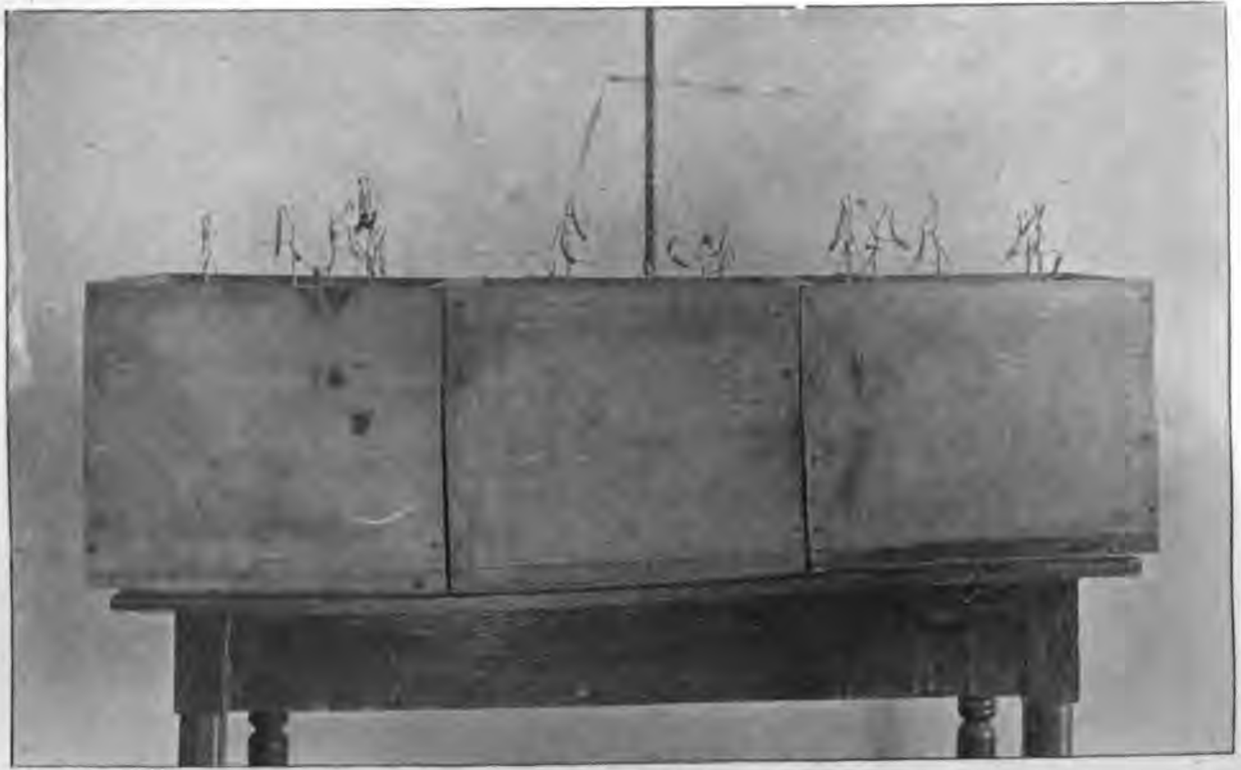
EXPERIMENT WITH BARLEY.

Set.	Manure per box.	No. of box.	Total crop.	Grain.
I B....	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	78 grams	19 grams
		2	54 grams	9 grams
		3	83 grams	16 grams
		Total..	215 grams	44 grams
II B...	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and crude South Carolina rock, 17.0 grams.	1	88 grams	22 grams
		2	118 grams	18 grams
		3	106 grams	21 grams
		Total..	312 grams	61 grams
III B..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	174 grams	4 grams
		2	175 grams	3 grams
		3	189 grams	10 grams
		Total..	538 grams	17 grams

Dry matter.

Set I B	201.5 grams
Set II B	294.9 grams
Set III B	508.1 grams

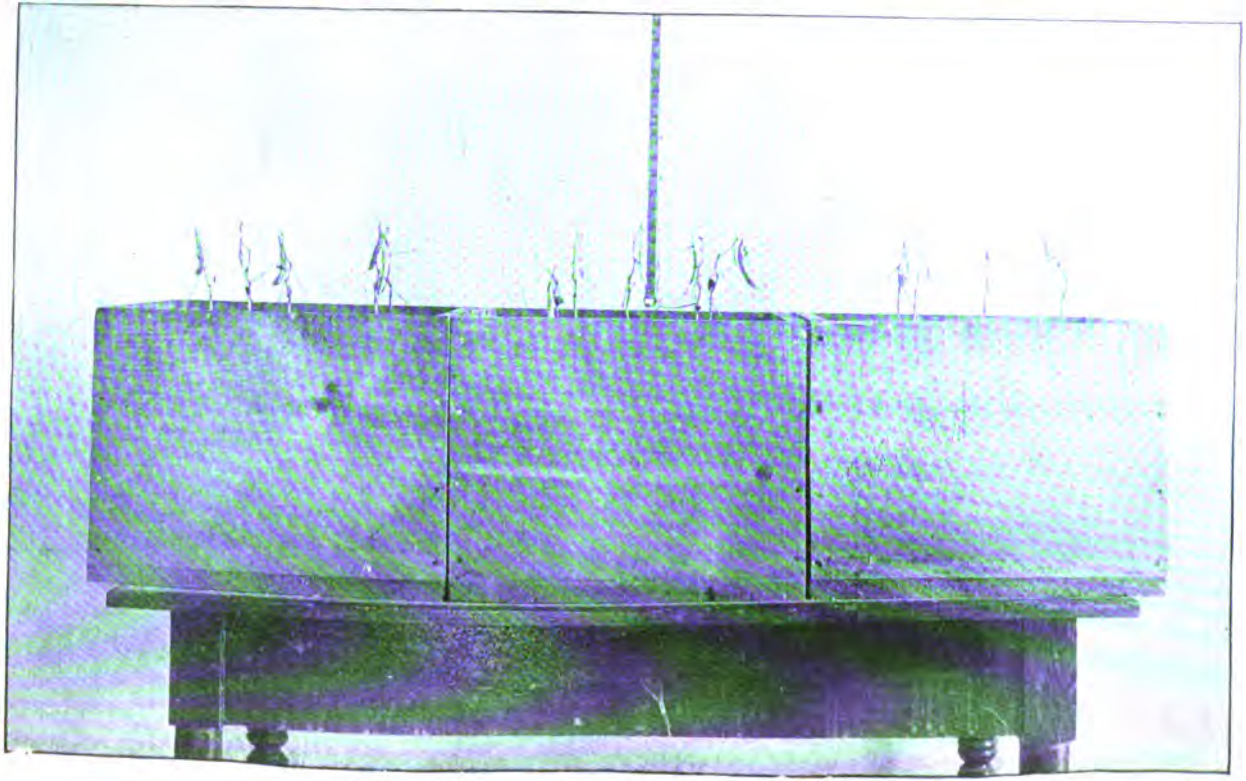
PLATE I. D.



CROP, BEANS.

Manure.—Nitrate of Soda, Muriate of Potash.

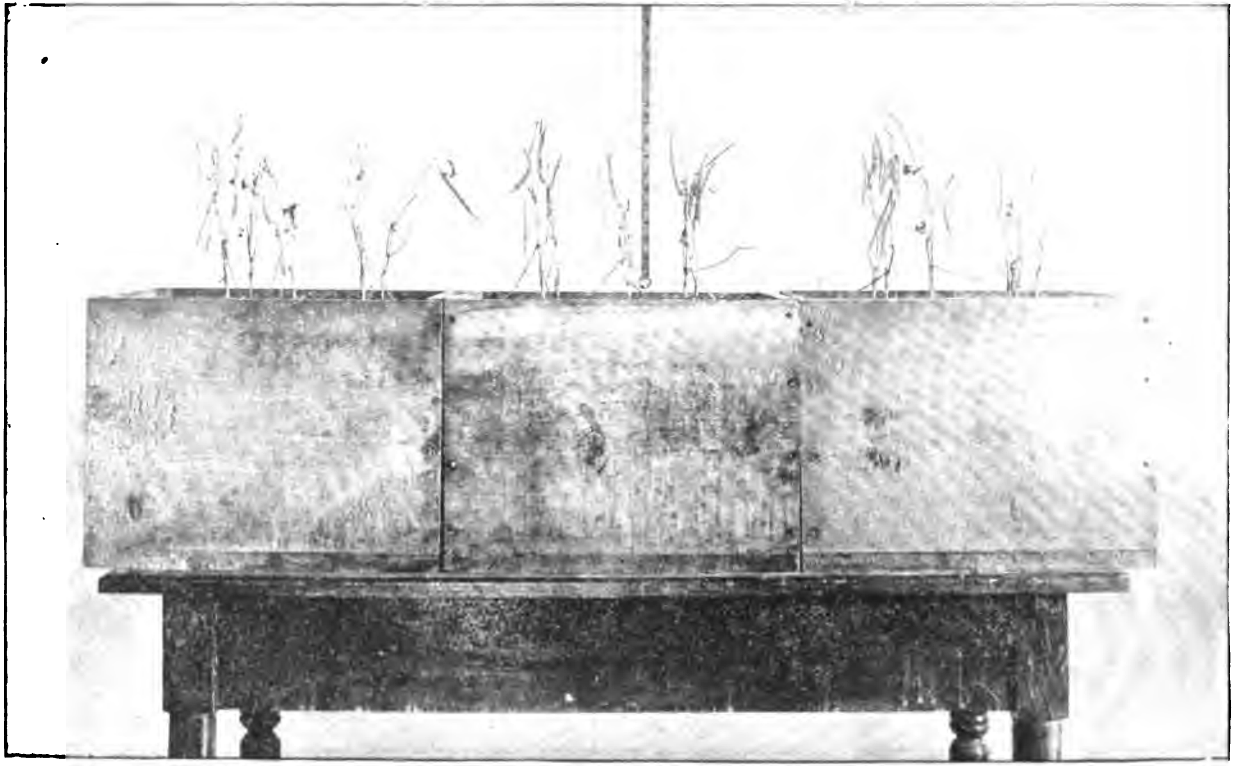
PLATE II. D.



CROP, BEANS.

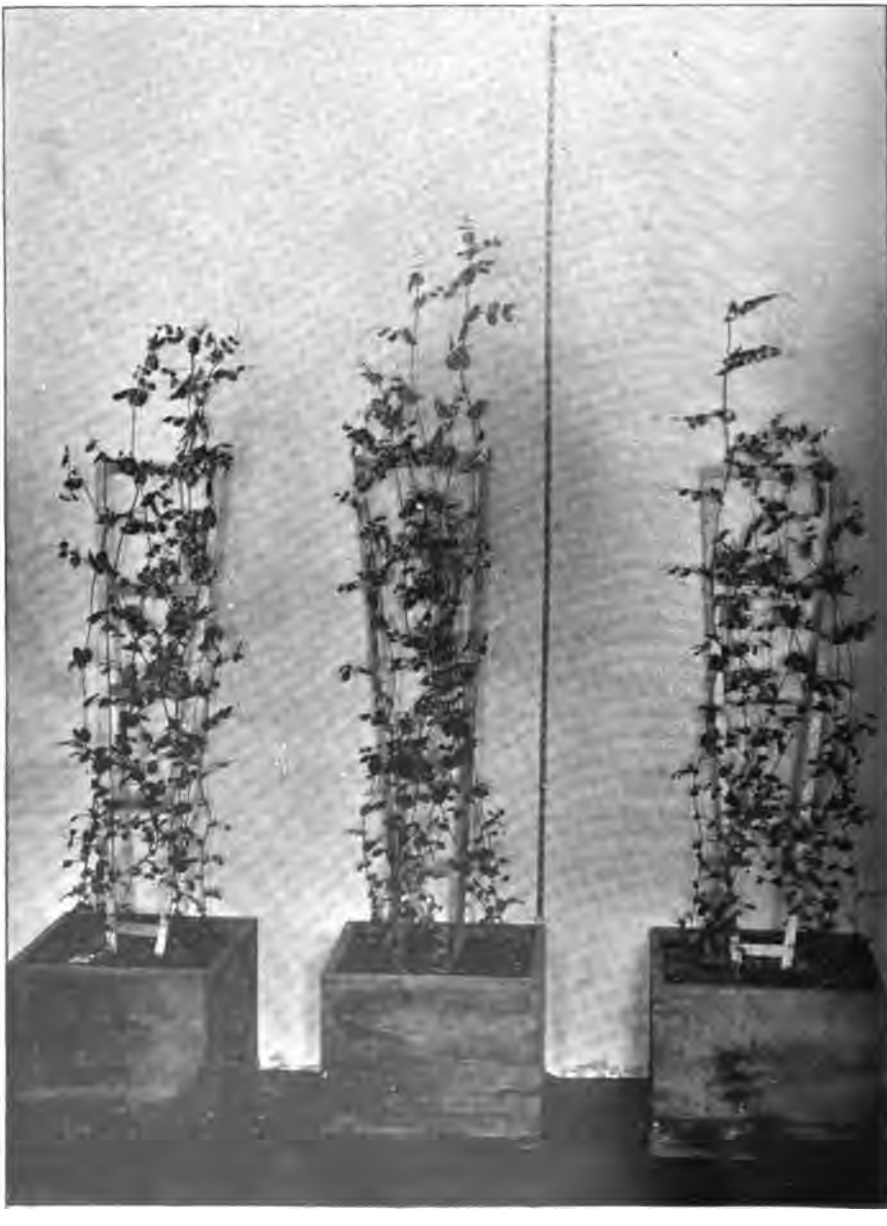
Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.

PLATE III. D.

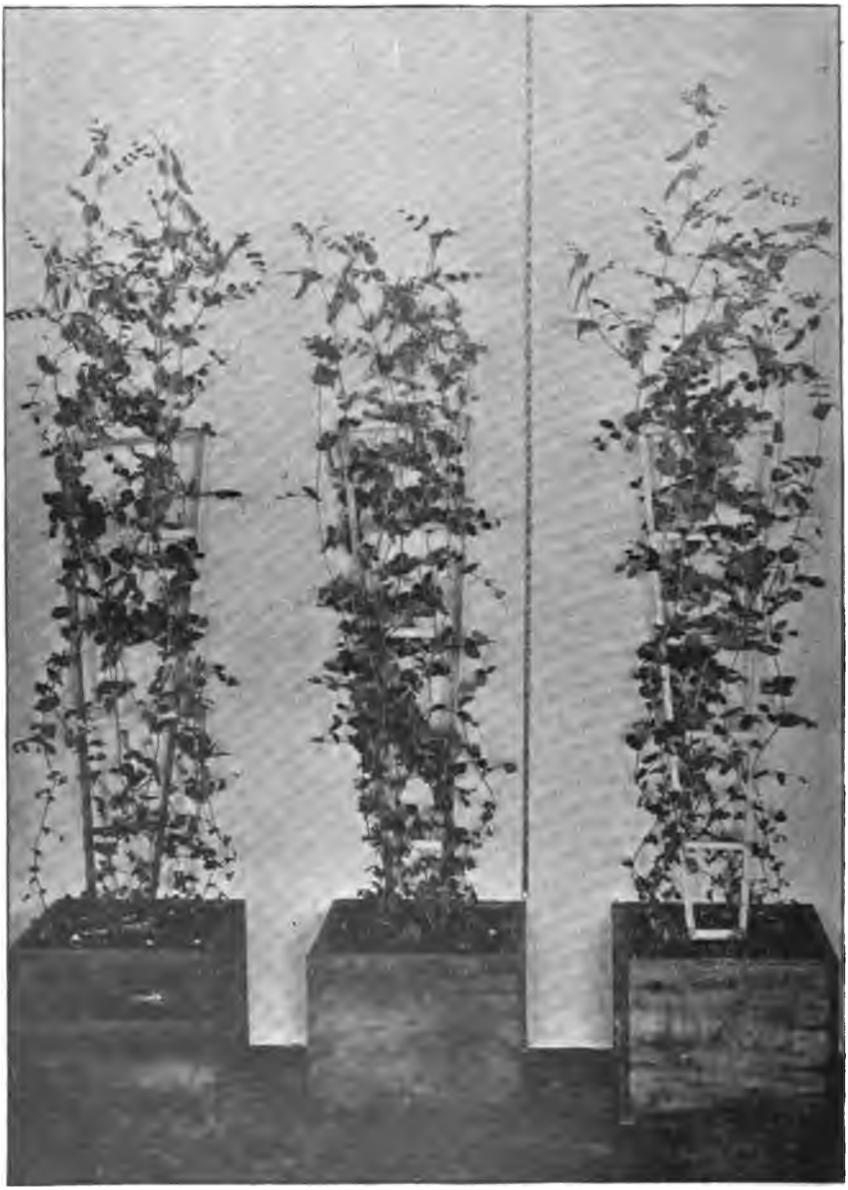


CROP, BEANS.

Manure,– Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

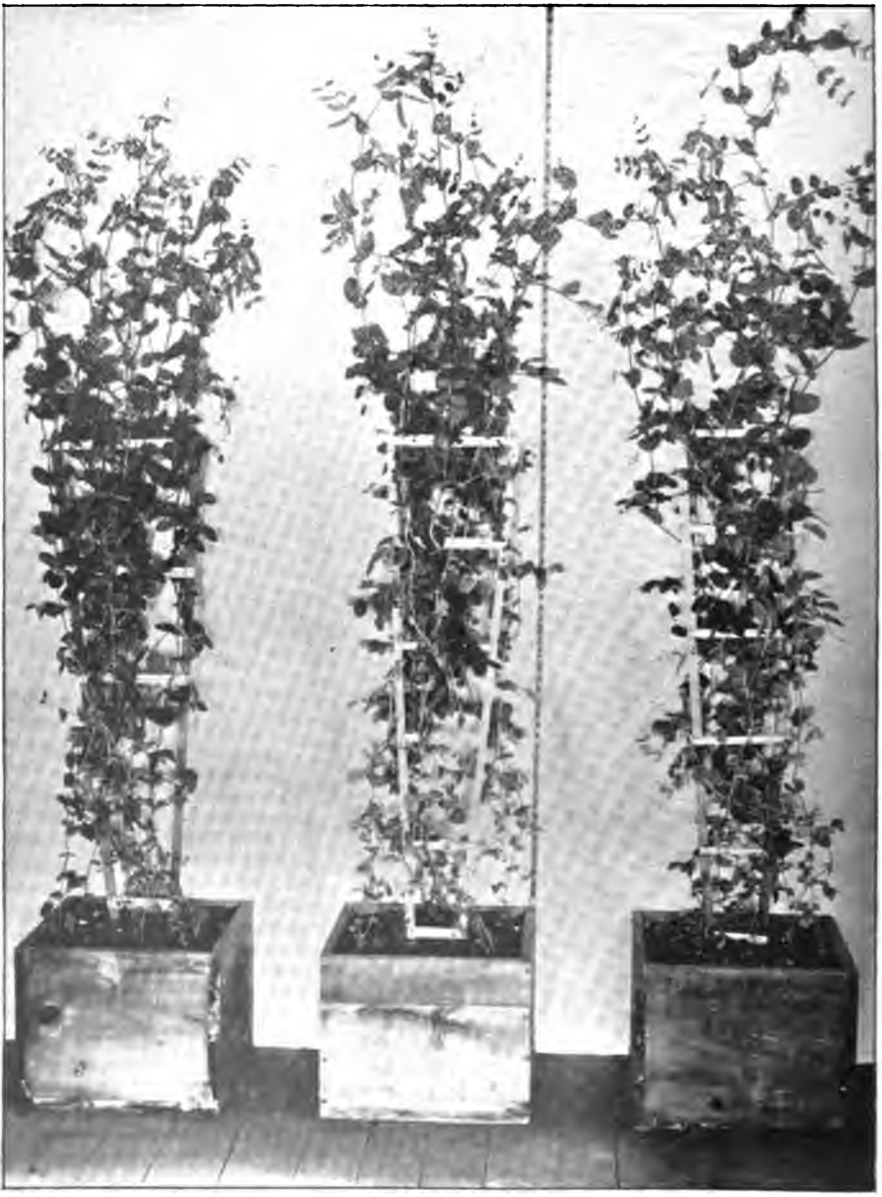


CROP, PEAS.
Manure,— Nitrate of Soda, Muriate of Potash.



CROP, PEAS.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.



CROP, PEAS.

Manure, — Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

TABLE V.

EXPERIMENT WITH PEAS.

Set.	Manure per box.	No. of box.	Total crop.	Peas in pod.
I E..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	35 grams	7 grams
		2	41 grams	11 grams
		3	45 grams	14 grams
		Total..	121 grams	32 grams
II E..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	73 grams	16 grams
		2	68 grams	17 grams
		3	70 grams	17 grams
		Total..	221 grams	50 grams
III E..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	83 grams	16 grams
		2	78 grams	17 grams
		3	84 grams	18 grams
		Total..	245 grams	51 grams

Dry matter.

Set I E..	112.7 grams
Set II E..	196.7 grams
Set III E..	228.6 grams

TABLE VI.

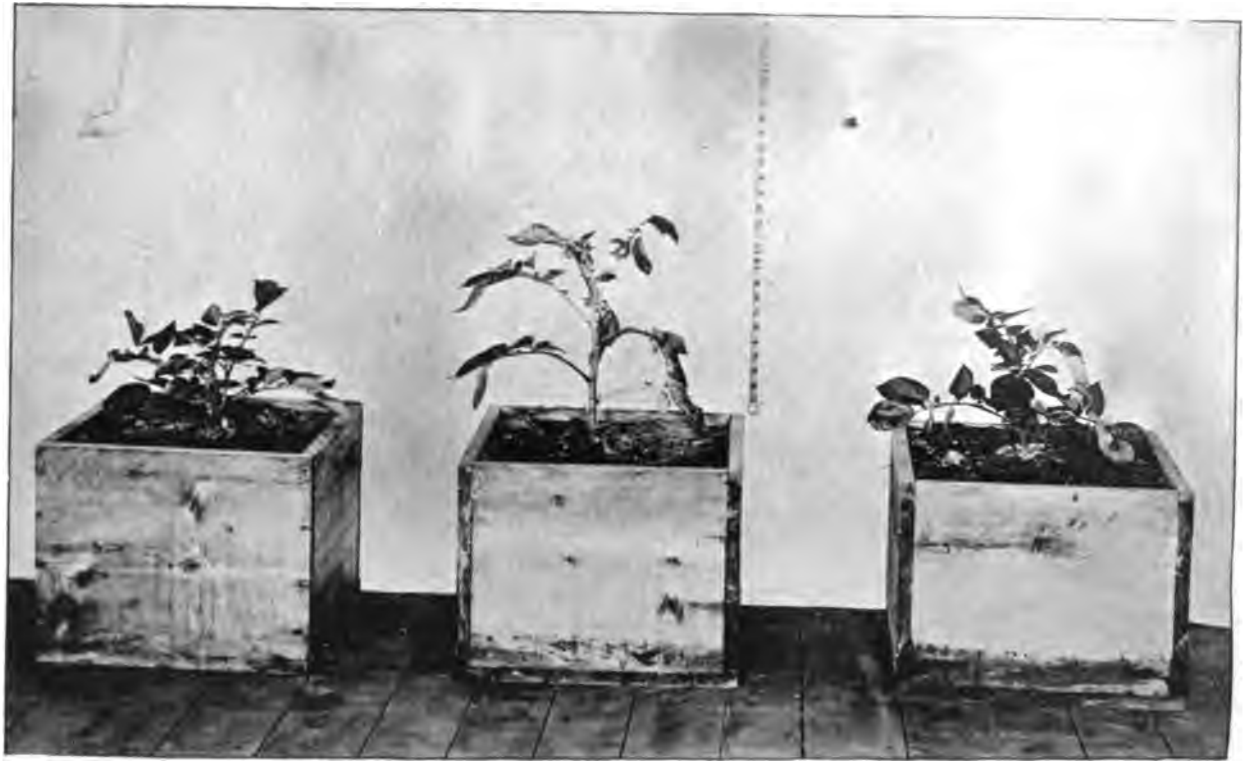
EXPERIMENT WITH POTATOES.

Set.	Manure per box.	No. of box.	Tubers.
I F..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	162 grams
		2	170 grams
		3	195 grams
		Total..	527 grams
II F..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	211 grams
		2	177 grams
		3	152 grams
		Total..	540 grams
III F..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	326 grams
		2	321 grams
		3	361 grams
		Total..	1008 grams

Dry matter, including tops.

Set I F	113.3 grams
Set II F	114.6 grams
Set III F	223.6 grams

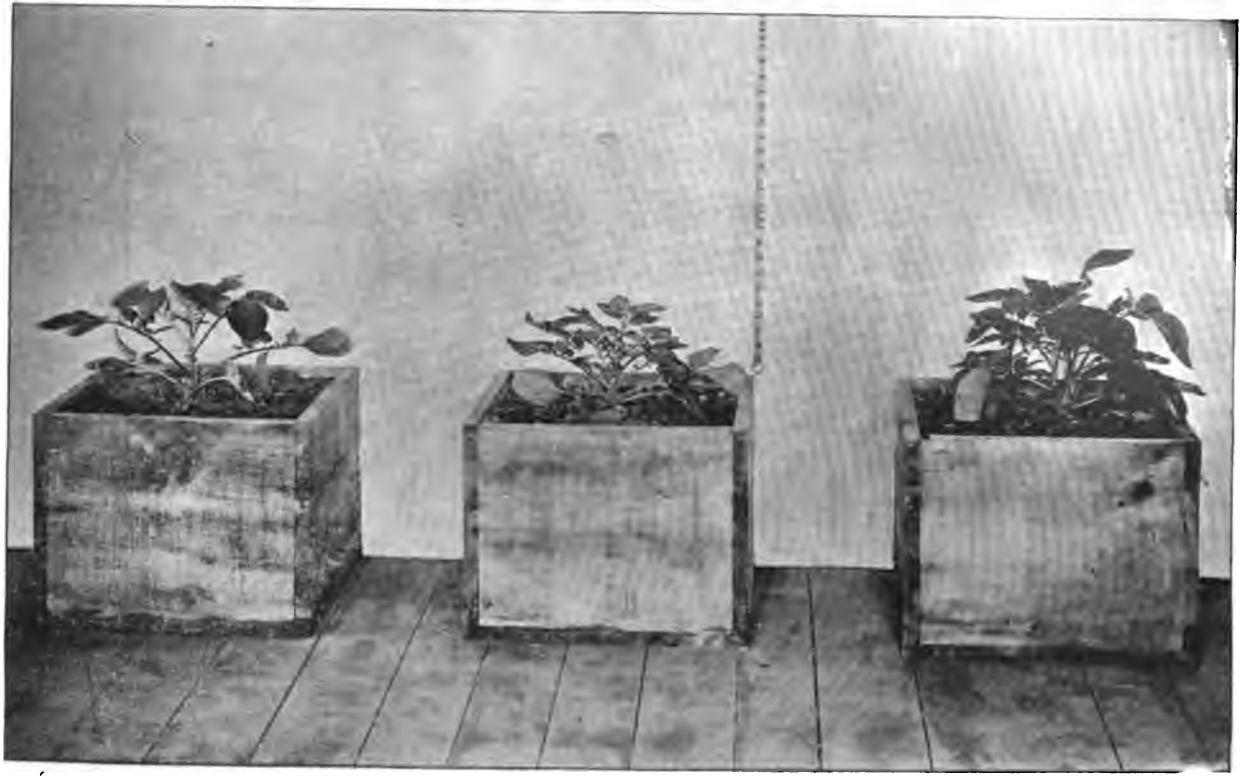
PLATE I. F.



CROP, POTATOES.

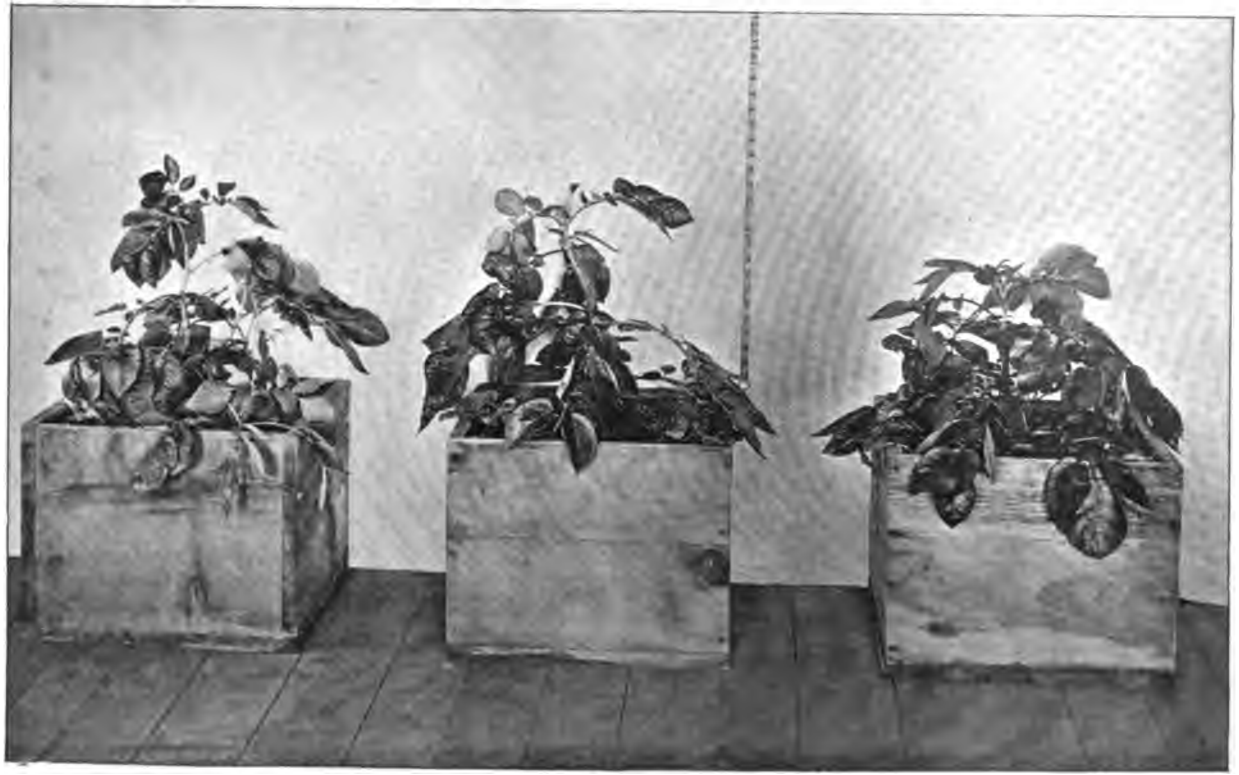
Manure,—Nitrate of Soda, Muriate of Potash.

PLATE II. F.



CROP, POTATOES.

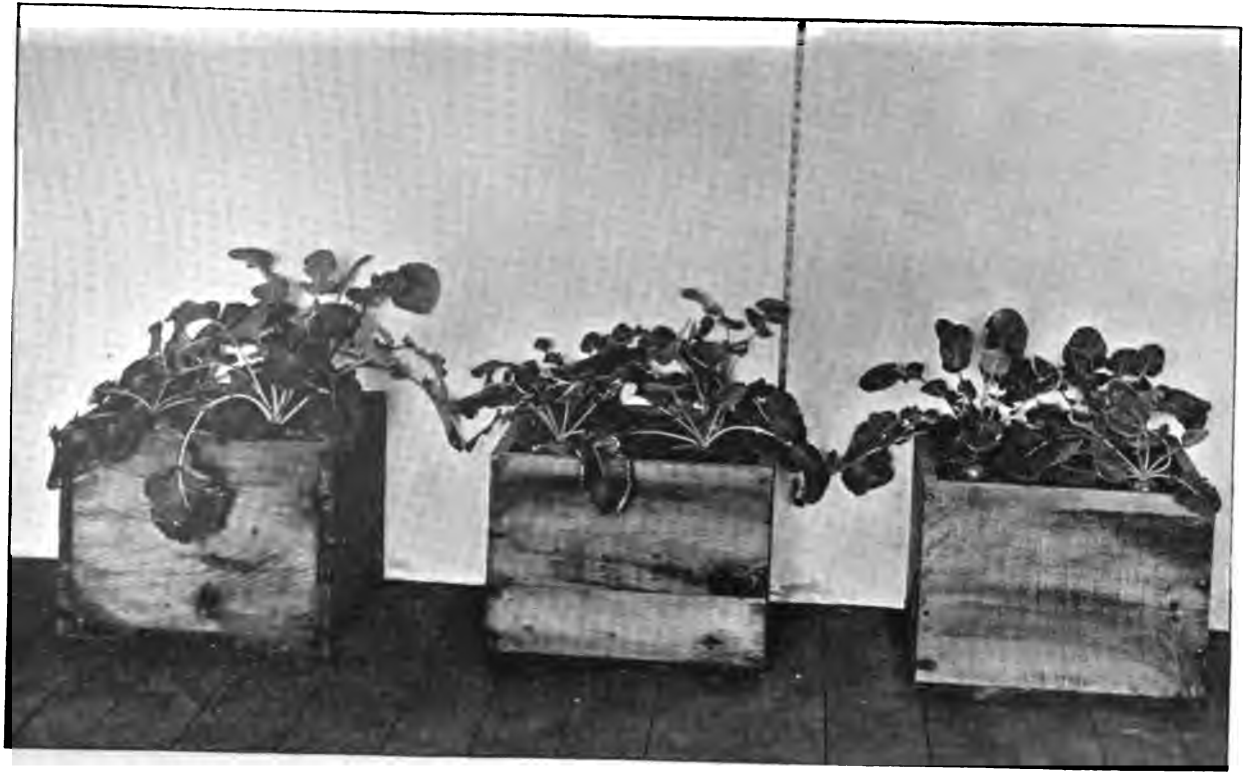
Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.



CROP, POTATOES.

Manure,—Nitrate of Soda, Muriate of Potash, Acidulated S. C. Rock Phosphate.

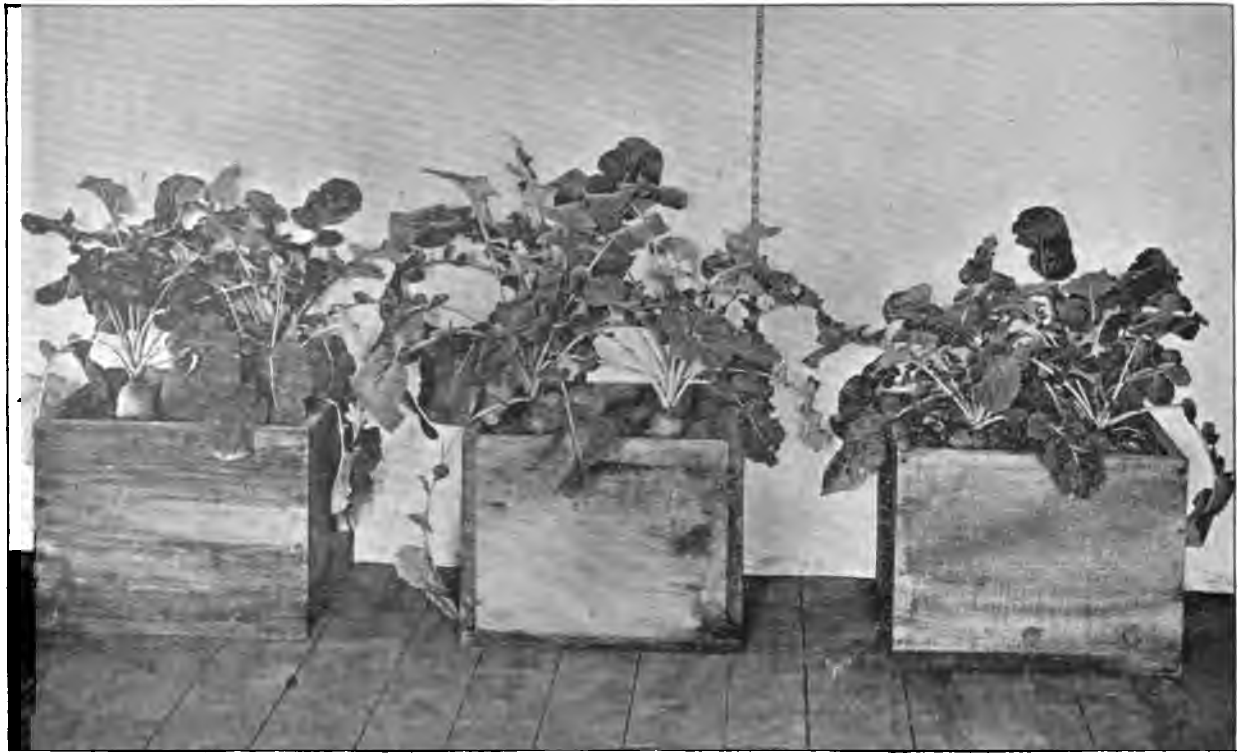
PLATE I. C.



CROP, TURNIPS.

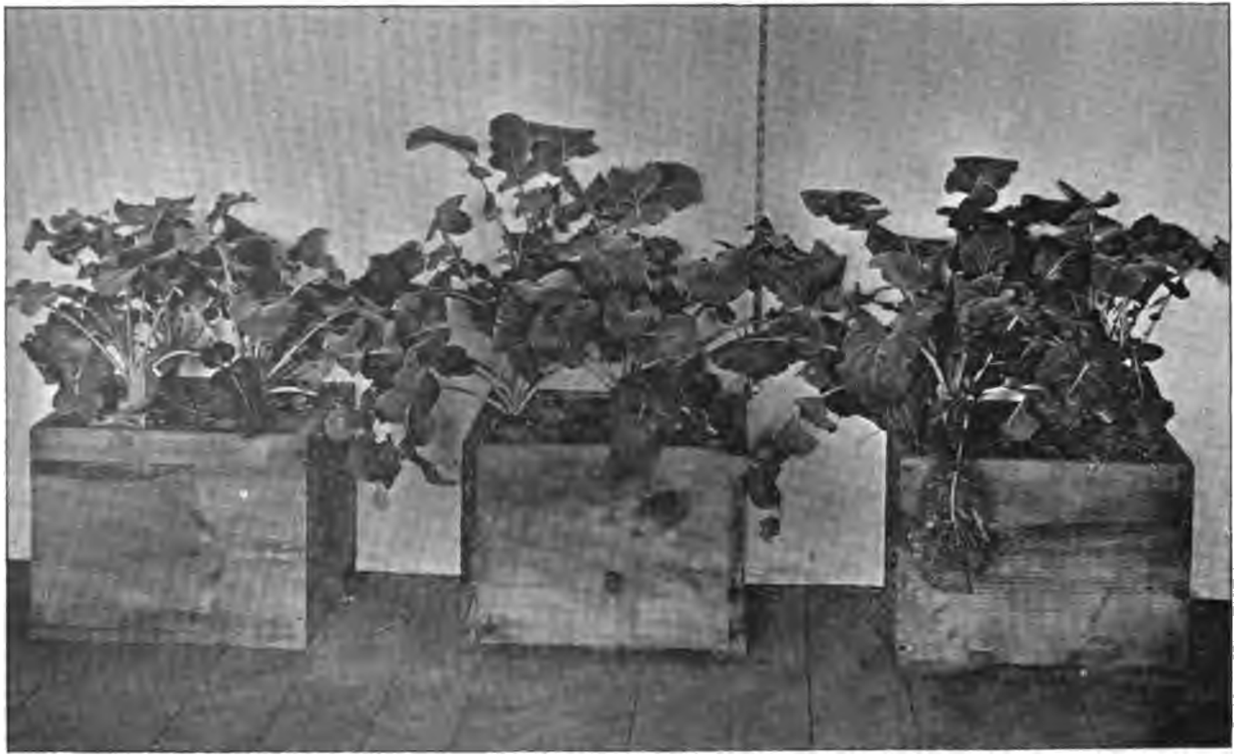
Manure,—Nitrate of Soda, Muriate of Potash.

PLATE II. G.



CROP, TURNIPS.

Manure,—Nitrate of Soda, Muriate of Potash, S. C. Rock Phosphate.



CROP, TURNIPS.

Nitrate of Soda. Muriate of Potash. Acidulated S. C. Rock Phosphate.

TABLE VII.

EXPERIMENT WITH TURNIPS.

Set.	Manure per box.	No. of box.	Total crop.	Roots.
I G..	Nitrate of soda, 8.5 grams, and muriate of potash, 2.6 grams.	1	398 grams	249 grams
		2	358 grams	233 grams
		3	542 grams	340 grams
		Total..	1298 grams	822 grams
II G..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and South Carolina rock, 17.0 grams.	1	914 grams	504 grams
		2	907 grams	616 grams
		3	947 grams	571 grams
		Total..	2768 grams	1691 grams
III G..	Nitrate of soda, 8.5 grams, muriate of potash, 2.6 grams, and acidulated South Carolina rock, 28.5 grams.	1	1055 grams	600 grams
		2	819 grams	406 grams
		3	925 grams	438 grams
		Total..	2799 grams	1444 grams

Dry matter.

Set I G	154.4 grams
Set II G	304.1 grams
Set III G	270.4 grams

The following table gives a partial chemical analysis of the total crop produced in each set of boxes, calculated on the water free substance.

TABLE VIII.

ANALYSIS OF ENTIRE CROP CALCULATED TO A WATER FREE BASIS.

	Nitrogen. N.—%.	Ash—%.	Sand and silica—%.	Potash K_2O—%.	Soda Na_2O—%.	Iron and alumina Fl_2O_3 Al_2O_3—%.	Phosphoric acid P_2O_5—%.	Sulphuric acid SO_3—%.	Chlorine Cl—%.
Wheat, Set I A.	1.36	4.19	1.23	1.37	.08	.24	.14	.14	.36
II A.	1.34	4.05	1.27	1.29	.13	.21	.21	.17	.34
III A.	1.28	4.87	1.95	1.23	.07	.31	.39	.25	.30
Barley, Set I B	1.65	8.19	.60	3.13	.49	.27	.20	.14	2.24
II B.	1.48	7.61	1.18	2.71	.44	.29	.19	.20	1.76
III B.	1.57	9.23	.83	2.33	1.62	.14	.29	.40	2.60
Corn, Set I C.	1.55	9.33	5.03	1.35	.05	–	.21	.16	.20
II C.	1.49	6.85	3.31	1.31	.08	.38	.27	.17	.21
III C.	0.84	5.40	1.47	1.79	.10	.21	.29	.19	.49
Beans, Set I D.	3.75	19.23	9.63	1.98	.16	–	.27	.23	
II D.	3.65	18.50	8.99	1.92	.18	–	.31	.27	
III D.	2.80	12.43	4.52	2.16	.07	.49	.41	.26	.59
Peas, Set I E.	2.52	8.34	.76	2.03	.28	.17	.30	.18	.91
II E.	2.37	9.57	1.17	2.26	.33	.37	.30	.20	.96
III E.	2.19	9.05	.71	2.23	.34	.61	.28	.30	1.03
Potatoes, Set I F.	1.69	11.46	5.88	2.79	.11	.55	.28	.23	.45
II F.	2.02	10.62	4.28	2.95	.14	.47	.29	.32	.51
III F.	2.03	11.94	4.34	3.49	.21	.39	.40	.29	.69
Turnips, Set I G.	2.87	12.30	1.03	3.22	1.03	.25	.48	.20	1.38
II G.	2.75	12.50	1.79	3.18	1.62	.23	.70	.40	1.28
III G.	3.37	13.33	1.01	3.60	1.89	.22	.76	1.20	1.23

While it may not be desirable to draw definite conclusions from so small an amount of data as is furnished by the above described experiments, there are some points which under the conditions of these experiments the results appear to bring out sharply.

1st. Different crops showed a decided difference in their powers of obtaining phosphoric acid from crude, finely ground South Carolina rock. Wheat, barley, corn, peas and turnips apparently appropriated the insoluble phosphoric acid from this source with greater or less ease, while beans and potatoes derived no benefit from it.

2d. The greatest practical advantage derived from the use of fine-ground South Carolina rock was with the turnips. With this crop a larger weight of dry matter and also a larger weight of fresh roots was obtained with insoluble phosphoric acid from the finely ground South Carolina rock than with an equal amount of soluble phosphoric acid from acidulated South Carolina rock.

3d. The indications point to a profitable use of finely ground South Carolina rock as a manure for barley and peas as well as turnips.

4th. The acidulated South Carolina rock in these experiments apparently depressed the yield of grain with barley while largely increasing the amount of straw. With wheat both grain and straw were largely increased and in about the same proportion.

ANALYSES OF CATTLE FOODS.

W. H. JORDAN, J. M. BARTLETT, L. H. MERRILL.

NOTE—The experiments in connection with which these analyses were made were planned largely by the Station Director. The analyses were entirely executed by the Station chemists. The Director is responsible for this discussion of the results.

It seems proper, because of certain views now held by agricultural chemists, that the following statement of the analyses of various cattle foods should be accompanied by explanations.

The opinion is now frequently expressed that to continue the analysis of our common cattle foods after the existing usual methods, simply for the sake of analysis, is largely a waste of time. This opinion is undoubtedly correct, and for the following reasons: 1st. Enough analyses have been made to establish the average composition of our common feeding stuffs as closely as is practicable or useful. Additional analyses will change the general averages very little.

2nd. Existing methods of food analysis are furnishing no new information about food compounds and are entirely inadequate to aid in solving the problems in animal nutrition which now most urgently demand consideration.

There is an increasing need for a more intimate study of the properties of the individual compounds of cattle foods and their relation to nutritive processes.

Nevertheless, analyses of the foods involved in experimental work even by our confessedly unsatisfactory methods, are both necessary and useful, because they disclose certain facts which are fundamental conditions, and a knowledge of which is essential to successful plans and to any well grounded conclusions.

The analyses herewith reported have nearly all been occasioned by experimental work either in studying crop production or along the line of animal nutrition. However, some attempt has been made to step outside the beaten path by endeavoring to ascertain the amount present of those carbohydrates whose properties and functions are to a large degree understood. Certain sugars and the starchs are among our best known vegetable compounds, not only as to their constitution but also as to their offices in the animal body. We have every reason to regard them as the most valuable of the nutrients usually classed under the term "nitrogen-free-extract," and it is reasonable to believe that the nutritive value of this nitrogen-free-extract varies materially according as it contains largely such compounds as sucrose, glucose and starch, which are entirely digestible and directly useful, or is almost wholly made up of bodies of which we have scanty knowledge, the little we do know not being favorable to their efficiency as food. Therefore in the experiments which this Station has made with the corn crop, not only have the regular analyses been performed, but the amounts of sugars and starch have been ascertained as closely as existing methods would allow.

THE COMPOSITION OF FODDERS AND SILAGE FROM THE CORN (MAIZE) PLANT.

The analyses which appear below have been made during the past three years in connection with experiments in the value of the corn plant as a source of cattle food. They have been necessary in order to know the amount and general character of the dry matter produced, and have been required in the digestion and feeding experiments.

TABLE IX.

COMPOSITION OF CORN FODDER AND CORN SILAGE FROM CORN GROWN ON THE STATION EXPERIMENTAL PLATS.

	Parts in 100 of the Green or Air-Dry Material.						Parts in 100 of the Water-Free Material.				
	Water.	Ash.	Protein—N x 6.25.	Fiber.	Nitrogen-free-extract.	Fat.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Crop of 1891.											
CXLVII—Southern Corn, large white, immature, no ears	86.48	.99	1.70	4.33	6.22	.28	7.31	12.25	32.06	46.32	2.06
CXLVI—Maine Field Corn, mature, kernels glazed	86.48	.84	1.70	4.13	6.57	.28	6.25	12.22	30.56	48.95	2.02
CXLVIII—Sweet Corn, mature	86.19	.87	1.92	3.91	6.73	.45	6.29	13.96	27.74	48.72	3.29
Crop of 1892.											
CLX—Southern Corn, large white, immature, no ears	85.33	1.21	1.78	4.03	7.37	.28	8.24	12.14	27.45	50.22	1.95
CLXI—Southern Corn, large white, immature, no ears	85.85	1.04	1.75	4.08	6.93	.36	7.38	12.24	28.86	48.96	2.56
CLXII—Maine Field Corn, mature, kernels partly glazed	79.11	1.25	2.26	3.86	12.84	.68	5.98	10.83	18.48	61.46	3.25
CLXIII—Maine Field Corn, mature, kernels partly glazed	81.38	1.10	2.15	3.92	10.93	.52	5.89	11.53	21.04	58.74	2.80
CLXX—Southern Corn silage, from CLX	86.50	1.11	1.69	4.03	6.30	.37	8.21	12.52	29.85	46.64	2.78
CLXXVI—Southern Corn silage, from CLXI	83.80	1.03	2.60	4.89	6.94	.74	6.35	16.02	30.17	42.84	4.62
CLXXI—Maine Field Corn silage, from CLXII	77.70	1.28	2.25	4.73	13.23	.81	5.74	10.10	21.21	59.31	3.64
CLXXIII—Maine Field Corn silage, from CLXIII	79.60	.97	2.09	4.72	11.81	.81	4.74	10.23	23.13	57.91	3.99
Crop of 1893.											
CCXXIV—Southern Corn, large white, immature, no ears	84.55	1.29	1.57	4.35	7.90	.34	8.34	10.16	28.18	51.10	2.22
CCXXV—Southern Corn, large white, immature, no ears	83.42	1.17	2.04	4.36	8.62	.39	7.06	12.32	26.31	51.94	2.37
CCXXVI—Maine Field Corn, mature, kernels partly glazed	80.51	1.25	2.37	4.10	11.27	.50	6.41	12.16	21.06	57.81	2.56
CCXXVII—Maine Field Corn, cut August 15th, immature, no kernels formed	88.29	1.09	1.75	3.10	5.46	.30	9.33	14.96	26.51	46.60	2.60
CCXXVIII—Maine Field Corn, cut August 28th	82.50	1.14	2.05	4.08	9.71	.52	6.50	11.74	23.31	55.50	2.95
CCXXIX—Maine Field Corn, cut September 4th	80.45	1.21	2.22	3.85	11.68	.59	6.21	11.38	19.67	59.74	3.00
CCXXX—Maine Field Corn, cut September 12th	76.83	1.29	2.22	4.48	14.50	.68	5.58	9.57	19.33	62.52	3.00
CCXXXI—Maine Field Corn, cut September 21st, mature, kernels partly glazed, rapidly dried	74.66	1.50	2.34	4.71	16.04	.75	5.91	9.23	18.60	63.30	2.96
CCXXXII—Maine Field Corn, same as CCXXXI, dried slowly, without heat	78.24	1.55	2.29	4.67	12.63	.62	7.14	10.54	21.39	58.08	2.85

The above mass of figures give information on two points which are worthy of consideration by Maine farmers; viz: (1) The comparative composition of the large Southern varieties of corn, which are so often grown in Maine for fodder purposes, and the Northern field corn such as matures in Maine, which is regarded by many as the more valuable variety for use in this State.

(2) The effect of the degree of maturity of the corn plant upon its composition. The large varieties of corn *must* be cut in this State when very immature, and our own small field corn *may* be cut in any stage of maturity. What is the effect of immaturity upon the value of the plant as a food?

THE COMPARATIVE COMPOSITION OF THE LARGE SOUTHERN CORN AND THE SMALLER MAINE FIELD CORN, THE FORMER IMMATURE WHEN CUT AND THE LATTER MATURE.

Observations on these two varieties of corn have been made for five years and in the averages given below, there are included analyses already published in the reports of this Station for 1889 and 1891. The analyses for the years 1888, 1890 and 1891 are averaged separately from those of 1892 and 1893 for the reason that the samples for the first three years were obtained in a way that probably allowed a material change in their composition. In 1888, 1890 and 1891 several hundred pounds of the green plant were stored under cover in such a manner as to partially air-dry without any apparent fermentation or decay, and the fodder was not analyzed until it had stood in this condition for several months, when it was used for digestion experiments. Doubtless these fodders had suffered changes incident to the slow drying of large succulent plants, even under the most favorable conditions. In 1892 and 1893, immediately upon cutting in the field, several hundred pounds of the perfectly fresh material were finely chopped and crushed, a portion of which was rapidly dried in a steam closet. Facts given later indicate that the latter method of procedure much more fully preserved the original condition of the plant than the former, and so the analyses for the last two years are the more trustworthy as a means of ascertaining the nature of the growth which actually occurred.

It should be remarked, also that while the crops of Maine field corn must be regarded as mature in 1888, 1889 and 1890, they were much more heavily eared in 1892 and 1893.

TABLE X.

RELATIVE COMPOSITION OF TWO VARIETIES OF CORN (GREEN).

	In 100 parts fresh substance.						
Crops of 1888, 1890 and 1891—Average.	Water.	Dry substance.	Ash.	Protein N × 6.25.	Fiber.	Nitrogen-free-extract	Fat.
Southern Corn, immature	86.41	13.59	1.05	1.61	4.28	6.30	.35
Maine Field Corn, mature	84.43	15.57	1.13	1.92	4.39	7.73	.40
Excess in Field Corn	-	1.98	.08	.31	.11	1.43	.05
Crops of 1892 and 1893—Average.							
Southern Corn, immature	84.80	15.20	1.18	1.78	4.20	7.70	.34
Maine Field Corn, mature	78.91	21.09	1.28	2.28	4.15	12.77	.61
Excess in Field Corn	-	5.89	.10	.50	—.05	5.07	.27

It appears from these averages that under the conditions existing in Maine, which require the cutting of the large varieties of corn in an immature state, the Maine field corn which reaches maturity, contains the larger percentage of dry matter. This is true especially of the years 1892 and 1893, when the latter crop was more perfectly developed. Again, the excess of dry matter in the Maine field corn consists almost wholly of the non-nitrogenous compounds classed under the head of nitrogen-free-extract. The characteristic differences in the composition of the dry substance of the two varieties of corn are more clearly seen by a comparison in the water-free condition.

TABLE XI.

COMPOSITION OF THE WATER-FREE SUBSTANCE OF TWO VARIETIES OF CORN.

	In 100 parts water-free substance.				
Average for 1892 and 1893.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Southern Corn, immature	7.76	11.72	27.70	50.54	2.28
Maine Field Corn, mature	6.05	10.94	19.79	60.33	2.89
Differences	+.71	+.78	+7.91	—9.89	—.61

The dry substance of the larger and immature corn contains more ash protein and fiber and less nitrogen-free-extract and fat. The much larger percentage of fiber and greatly less percentage of nitrogen-free-extract are the noteworthy differences.

THE INFLUENCE OF MATURITY UPON THE COMPOSITION OF THE CORN PLANT.

The figures above cited compare two varieties of corn in unlike stages of maturity and show important differences in composition. Is this a question of maturity or of variety? In order to obtain testimony on this point, in 1893 field No. 1 of Maine field corn was cut in five different lots, ranging in times of cutting from August 15th to September 21st, and in stage of growth from the early formation of the ear to full maturity. The analyses of samples from these different cuttings appear in Table 1 but are reproduced below.

TABLE XII.

COMPOSITION OF CORN CUT AT DIFFERENT PERIODS OF GROWTH.

	In 100 parts fresh substance.						
	Water.	Dry substance.	Ash.	Protein N × 6.25.	Fiber.	Nitrogen-free-extract.	Fat.
Maine Field Corn, cut August 15th..	88.29	11.71	1.09	1.75	3.10	5.46	.30
August 28th..	82.50	17.50	1.14	2.05	4.08	9.71	.52
Sept. 4th. ...	80.45	19.55	1.21	2.22	3.83	11.68	.59
Sept. 12th....	76.83	23.17	1.29	2.22	4.48	14.50	.68
Sept. 21st	74.66	25.34	1.50	2.34	4.71	16.04	.75

The immature and mature corn differ in the following essential particulars:

(1) The mature corn is less watery: i. e. it contains a much larger percentage of dry substance. During the thirty days before the mature crop was harvested there was a continuous and large increase in the percentage of dry matter. It will appear later that this was due to an actual growth of dry matter, rather to a drying out of the water with a diminished weight of crop.

(2) This increase was most largely from the growth of compounds classed as nitrogen-free-extract, such as starch, sugar and allied bodies.

This is most clearly shown by the arrangement of figures in Table 13:

TABLE XIII.

RELATION OF DIFFERENT CLASSES OF COMPOUNDS IN CORN CUT AT DIFFERENT PERIODS OF GROWTH.

	In 100 pounds of green corn as cut.		
	Pounds of dry matter.	Pounds of nitrogen-free-extract.	Pounds of all compounds other than nitrogen-free-extract.
Lot cut August 15th, very immature	11.71	5.46	6.25
August 28th	17.50	9.71	7.79
September 4th	19.55	11.68	7.87
September 12th	23.17	14.50	8.67
September 21st, mature	25.34	16.04	9.30

Lot cut August 15th ....Other compounds: Nitrogen-free-extract:: 100: 87.3
Lot cut August 28th ....Other compounds: Nitrogen-free-extract:: 100:124.6
Lot cut September 4th ....Other compounds: Nitrogen-free-extract:: 100:148.4
Lot cut September 12th ....Other compounds: Nitrogen-free-extract:: 100:167.2
Lot cut September 21st..... ...Other compounds: Nitrogen-free-extract:: 100:175.4

The answer to our question must be, then, that the changes which are shown in the experiment with Maine field corn to be due to increasing maturity are those which exactly explain the differences between the two varieties of corn compared.

It seems impossible to avoid the conclusion that the inferiority of the larger Southern corn, when compared pound for pound with our smaller Northern variety, is caused in part, at least, by the necessity of harvesting it in an immature condition.

TO THE FORMATION OF WHAT COMPOUNDS IS DUE THE LARGE RELATIVE INCREASE OF NITROGEN-FREE-EXTRACT AS THE CORN PLANT APPROACHES MATURITY.

As before stated an attempt has been made to extend these analyses beyond the usual routine. This has been in the way of determinations of the sugars and starch, in order to learn the extent to which these more valuable carbohydrates are present in the corn plant, and the influence of certain conditions upon their amount.

It is believed that the percentages of starch given in this connection much more nearly represent the actual amounts present in the fodders analyzed than when the ordinary method of analysis is followed.*

The method of starch determination generally used is to treat the substance for a given period with hot dilute acid, which results in the conversion not only of starch but partly, at least, of cellulose and gums into glucose. The amount of this sugar is ascertained by its action in precipitating copper oxide from Fehling's solution and all the sugar thus found is assumed to come from starch alone, which is far from the truth. If we did not have reason to believe that starch is greatly superior in food value to the cellulose, gums, etc., which suffer hydrolysis by the action of mineral acids, this assumption would be less fatal to correct conclusions. But so long as starch appears to be entirely digestible, while these other bodies certainly are not, and so long as there is good reason for regarding digested cellulose and gums as less efficient nutrients than digested starch, it is certainly nothing less than absurd to go on assuming that all the sugar produced when vegetable substances are treated with mineral acids comes from starch. The method used here was the conversion of the starch into water-soluble compounds through the action of a ferment known as diastase In the case of a few samples the acid and diastase methods have been compared.

TABLE XIV.

COMPARISON OF PERCENTAGES OF STARCH AS FOUND BY THE ACID AND BY THE DIASTASE METHODS.

	In 100 parts water-free substance.			
	Total nitrogen-free-extract.	Starch, by diastase method.	"Starch," by acid method.	Excess, by acid method.
CLX—Southern Corn, immature, no ears, Field I....	50.22	2.03	14.98	12.95
CLXI—Southern Corn, immature, no ears, Field II..	48.86	2.24	15.27	13.03
CLXII—Maine Field Corn, mature, Field I...........	61.64	18.58	30.32	11.74
CLXIII—Maine Field Corn, mature, Field II..... ...	58.74	12.66	23.97	11.31
CLXX—Southern Corn silage, from CLX.........	46.64	3.70	14.63	10.93
CLXXVI—Southern Corn silage, from CLXI...... ...	42.84	3.56	14.90	11.35
CLXXI—Maine Field Corn silage, from CLXII.......	59.31	18.32	29.50	11.18
CLXXIII—Maine Field Corn silage, from CLXIII ...	57.91	17.43	30.00	12.57

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* Mr. Bartlett describes his methods on subsequent pages of this report.

The percentages of "starch" by the acid method are greatly but quite uniformly larger than by the diastase method, this excess ranging between 10 93 to 13.03 per cent of the total substance of the plant, or from 24.5 per cent to 31 per cent of the nitrogen-free-extract.

This uniformity of difference in the two methods, while proving nothing, is certainly favorable to confidence in the approximate accuracy of the diastase method, especially where the results range from 2 to 18 per cent. If, for instance, the low percentages of starch in the case of samples CLX CLXI, CLXX and CLXXVI and the high percentages in the other samples were due to the less perfect extraction of starch in the former, this fact would be disclosed by an increased excess with the acid method. As a matter of fact the acid method shows an excess only .36 per cent larger with the samples low in starch by the diastase methed. Moreover, Mr. Bartlett's report shows that an increase in the time of the action of the diastase beyond a certain limit failed to produce higher results, which makes it improbable that an undissolved residue of starch still existed.

The percentages of sugar and starch in all the samples analyzed in 1892 and 1893 appear in Table XV. In Table XVI are the averages for the immature Southern Corn and the mature Maine Field Corn.

TABLE XV.

PERCENTAGES OF SUGARS AND STARCH IN THE WHOLE CORN PLANT.

Crop of 1892.		Parts in 100 of water-free substance.				Parts of sugar & starch in 100 nitrogen-free-extract.
		Sugar.	Starch.	Total sugar and starch.	Total nitrogen-free-extract.	
Southern Corn, immature	Field 1..	13.03	2.03	15.06	50.22	30.0
	Field 2..	10.60	2.24	12.84	48.96	26.2
Maine Field Corn, mature	Field 1..	11 88	18.58	30.46	61.46	49.5
	Field 2..	11.40	12.66	24.06	58.74	40.9
Southern Corn, silage.......... from	Field 1..	-	3.70	3.70	46.64	7.9
	Field 2..	-	3.56	3.56	42.84	8.3
Maine Field Corn, silage . .....from	Field 1..	-	18.32	18.32	59.31	30.9
	Field 2..	-	17.43	17.43	57.91	30.1
Crop of 1893.						
Southern Corn, immature	Field 1..	13.34	-	13.34	51.10	26.1
	Field 2..	14.45	-	14.45	51.94	27.8
Maine Field Corn, mature	Field 2..	13.50	9.48	22.98	57.81	39.7
Maine Field Corn, very immature, cut Aug. 15th	Field 1..	11.70	-	11.70	46.60	25.1
Maine Field Corn, cut Aug. 28th	Field 1..	20.43	2.07	22.50	55.50	40.5
Sept. 4th	Field 1..	20.60	4.89	25.49	59.74	42.7
Sept. 12th	Field 1..	21.06	5.35	26.41	62.52	42.2
Maine Field Corn, mature, cut Sept. 21st	Field 1..	16.50	15.37	31.87	63.30	50.3

TABLE XVI.

COMPARISON OF PERCENTAGES OF SUGARS AND STARCH IN THE DRY SUBSTANCE OF IMMATURE AND MATURE CORN PLANT.

	Parts in 100 of water-free substance.				Parts of sugars and starch in 100 parts of nitrogen-free-extract.
	Sugars.	Starch.	Total sugars and starch.	Total nitrogen-free-extract.	
Southern Corn, immature, no ears, four samples	12.85	1.07	13.92	50.55	27.5
Maine Field Corn, mature, full ears, four samples	13.32	14.02	27.34	60.33	45.3
Excess in the Maine Field Corn	.47	12.95	13.42	9.78	17.8

There is a constant and striking difference between the percentages of starch in the Southern corn and in the Maine field corn. They are much larger in the latter kind. This is due undoubtedly to greater maturity. Only a small amount of starch appears to be deposited in the stalk and leaves, its rapid formation and storage in the plant apparently not beginning until the later development of the fruit or kernels. The analyses of Maine field corn in various stages show this fact very clearly. They also show that while a decrease in sugar occurred with the maturing of the ear, this was much less than the corresponding increase of starch, so that maturity shows a large excess over any other period of the more valuable carbohydrates.

There is, however, over four per cent less of sugar in the mature corn than at any period since the first one investigated. If the influence of maturity is in general to diminish the sugars present, less acidity of the silage would certainly result from the same cause. It appears, however, that there is not less, but rather more, sugar in the mature field corn than in the Southern corn, so that it is reasonable to expect, in these cases at least, fully as acid silage from the former variety.

THE EFFECT OF SLOW DRYING UPON THE COMPOSITION OF A SAMPLE OF A SUCCULENT PLANT.

It must be well known to chemists that in order to secure a sample of a watery plant like green corn, which shall correctly represent its composition, it is necessary that this sample be dried as promptly and as rapidly as possible with a reasonable degree of heat.

One or two experiences at this Station serve, however, to forcibly illustrate this fact.

At the time of cutting the 1893 crop of Maine field corn at different stages of growth it was desired to save some of the first and last cuttings for digestion trials. No means being available for drying the needed quantity by artificial heat, five hundred pounds of each cutting were finely chopped and spread very thinly on a scaffold in the Station barn, over at least six hundred square feet of surface. The doors and windows of the barn were open, which allowed a free circulation of air, and under these conditions the material was allowed to become air-dry. This was accomplished with no apparent moulding or fermentation. Before spreading the last cutting, the chopped material was very thoroughly mixed and a smaller sample of about twenty pounds was selected and taken at once to the Station laboratory, where it was rapidly dried in a steam closet. The following are the analyses of the slowly and rapidly dried samples.

TABLE XVII.

INFLUENCE OF METHOD OF DRYING UPON COMPOSITION OF CORN PLANT.

	In 100 parts fresh corn as cut.								
	Water.	Dry substance.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.	Sugars.	Starch.
Rapidly dried sample	74.66	25.34	1.50	2.34	4.71	16.04	.75	4.18	3.89
Slowly dried sample........	78.24	21.76	1.55	2.29	4.67	12.63	.62	1.72	3.66
Difference		3.58	.05	.05	.04	3.41	.13	2.46	.23

It seems that for each hundred pounds of green corn 3.58 per cent of dry matter was lost in the process of slow drying under the most favorable circumstances. This was 14.13 per cent of the total dry matter in the fresh plant, which means that of each hundred pounds of dry substance originally in the plant only 85.87 pounds were saved.

It is interesting to note that this loss falls almost entirely on the nitrogen-free extract, or carbohydrates, more than two-thirds of it being actually accounted for by the diminished percentage of sugars.

SUMMARY.

(1) The large varieties of corn which mature in the West and South must be harvested in Maine in a very immature condition, while the smaller Flint varieties may usually be allowed to stand until maturity.

(2) Under these conditions the smaller varieties of Flint corn had, when harvested, a much higher percentage of dry matter than the large immature Dent corn.

(3) The excess of dry matter in the Maine field corn consisted almost wholly of nitrogen-free-extract or the non-nitrogenous part of the plant.

(4) The dry matter of the large immature Dent corn contained .78 per cent more protein, 7.91 per cent more fiber and 9.89 per cent less nitrogen-free-extract.

(5) The development of the Flint corn to maturity caused a large relative production of nitrogen free extract as compared with an earlier stage of growth When in the silking stage the nitrogen-free-extract made up about 47 per cent of the dry matter of the plant, but this proportion increased to 63 per cent at maturity.

(6) The mature corn contained much the larger proportion of the more valuable carbohydrates, the sugars and starch. The starch especially increased, changing in an average of four samples from 1 per cent to 14 per cent of the dry substance of the plant.

(7) It appears from facts previously known, and from observations made in connection with these analyses that the diastase method of determining starch gives more nearly accurate results than the acid method.

(8) A material loss of dry matter is likely to occur when green corn fodder is slowly dried even under the most favorable conditions.

METHODS OF DETERMINING SUGAR AND STARCH.

J. M. BARTLETT.

Acid Method. The sugars are determined by the method described in Report Maine Experiment Station, 1888, page 207 and the acid method employed to extract starch was that given on page 208 of same report, except that a one per cent instead of a one-half per cent HCl solution was used.

Diastase Method. Four grams of the finely ground fodder are digested with 50 c. c. water on the steam-bath for one hour, and then 50 c. c. of a freshly prepared extract of malt are added. (The extract is made by placing fifty grams of powdered malt in a liter flask, filling to the mark with distilled water, and then after standing two hours with frequent shaking, the liquid is clarified by passing through a double filter.)

The digestion with the malt is carried on at a temperature of 65° C for four or five hours, which is sufficient time to bring the starch all into a soluble condition, no more being obtained by treating longer. This was shown by several trials. This liquid is then passed through a linen filter and the residue thoroughly washed with warm water, bringing the volume up to about 200 c. c. To complete the conversion of the starch to sugar, 20 c. c. of HCl (Sp. gr. 1 125) are now added and the whole digested on the steam-bath for three hours. After cooling, the liquid is neutralized with caustic potash, then four or five c. c. basic acetate of lead are added, the volume made up to the mark (200 c. c.) and filtered through a dry filter; 25 c. c. are then treated with Fehling solution, in the usual manner. If any lead remains in the solution, it must be removed with sulphurous acid before the Fehling solution is added.

DIGESTION EXPERIMENTS.

W. H. JORDAN.

The digestion experiments reported herewith show the results of three seasons work in that direction. They have been conducted largely as one means of studying the food value of the corn crop for cattle and because of the number of times the observations have been repeated with reasonably uniform results, they furnish to the Maine farmer data that may be considered fairly reliable. It has been deemed better to allow these figures to accumulate until they should constitute a safe basis for general statements, rather than publish them in a disconnected way as obtained. This has been also the more desirable because these trials are chiefly only a part of a general investigation covering several years.

The animals used have in all instances been sheep. The trials have covered a period of twelve or thirteen days, during the last five of which the fæces have been collected. These experiments have been especially free of mishaps, such as refusal to eat the entire ration, impaired health of the animals, or loss of dung from the collecting bags.

It is recognized, of course, that certain conditions operate to limit the accuracy and definiteness of digestion trials, such as individuality of animals, irregularity of excretion, the presence in the fæces of metabolic products which are not properly a part of the undigested food residues, and, in general, the present limitations of analytical methods, which do not admit of a satisfactory study of the digestibility of the various individual compounds of feeding stuffs. The first two conditions are overcome largely by averaging results simultaneously obtained with several animals, and it is hoped that future investigations will remove the difficulties caused by the existing lack of knowledge.

DIGESTIBILITY OF CORN FODDERS.

The various materials coming from the corn plant which have been made the subject of digestion trials not heretofore reported are as follows:

CXLVII. Southern Corn Fodder. Whole plant. Crop of 1891. Cut when the corn was immature, the formation of ears not having begun. Partially air-dried under cover, without showing any mould or decay.

CXLVI. Field Corn Fodder. Whole plant. Crop of 1891. Cut after the ears had become fully developed, the kernels being partially glazed. Partially air-dried under cover, without showing mould or decay.

CXLVIII. Sweet Corn Fodder. Whole plant. Crop of 1891. Cut after the ears had fully developed. Partially air-dried under cover, without showing mould or decay.

CLXX. Southern Corn Silage. Whole plant. Crop of 1892. Cut when immature, the formation of ears having merely begun on some stalks. Chopped and packed in silo. Silage good quality in appearance and flavor.

CLXXI. Field Corn Silage. Whole plant. Crop of 1892. Field No. 1. An abundant crop, heavily eared. Cut after ears had fully developed, the kernels being partially glazed. Chopped for silo. Silage very fine in appearance and flavor.

CLXXIII. Field Corn Silage. Whole plant. Crop of 1892. Field No. 2. A good crop well eared. Cut after the ears had fully developed, the kernels being partially glazed. Silage very fine in appearance and quality.

CCXXVII. Field Corn Fodder. Whole plant. Crop of 1893. Field No. I. Cut August 15th when formation of ears had only fairly begun. Chopped finely, spread very thinly on a scaffold and dried without any apparent fermentation.

CCXXXIII. Field Corn Fodder Whole plant. Crop of 1893. From same field as CCXXVII. Cut September 21st, after ears had fully developed and the the kernels were partially glazed. An abundant crop, heavily eared. Cut fine, spread very thinly on a scaffold and dried with no apparent fermentation.

The composition of the above named materials in the fresh and in the water-free condition is given on previous pages under the head of Analyses of Cattle Foods. Their composition at the time of using them in the digestion trials is stated below.

TABLE XVIII.

COMPOSITION OF FODDER MATERIALS AS FED IN DIGESTION EXPERIMENTS.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
CXLVII Southern Corn fodder, partially air-dried	50.50	3.61	6.06	15.87	22.94	1.03
CXLVI Field Corn fodder, partially air-dried	33.24	4.17	8.16	20.40	32.65	1.38
CXLVIII Sweet Corn fodder, partially air-dried	39.30	3.82	8.47	16.85	29.57	2.00
CLXX Southern Corn silage	86.50	1.11	1.69	4.03	6.30	.37
CLXXI Field Corn silage	77.70	1.28	2.25	4.73	13.23	.81
CLXXIII Field Corn silage	79.60	.97	2.09	4.72	11.81	.81
CCXXVII Field Corn fodder, air-dry	17.53	7.69	12.34	21.86	38.44	2.14
CCXXXIII Field Corn fodder, air-dry	18.93	5.79	8.55	17.34	47.08	2.31

The digestion coefficients of the fodders and silages previously described, as determined by actual trials, appear below. The data and necessary calculations can be found on subsequent pages.

TABLE XIX.

DIGESTION COEFFICIENTS OF CORN FODDERS AND CORN SILAGES.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
CXLVII—Southern Corn fodder, 1891	61.3	62.8	43.1	63.4	65.7	61.	59.
CXLVI—Field Corn fodder, 1891	72.7	74.2	50.7	67.6	78.6	73.8	64.7
CXLVIII—Sweet Corn fodder, 1891	70.9	72.7	44.	71.5	74.6	73.1	77.
CLXX—Southern Corn silage, 1892	64.4	65.8	48.2	64.8	66.7	65.4	67.8
CLXXI—Field Corn silage, 1892	78.	80.2	41.3	68.	77.9	83.1	80.9
CLXXIII—Field Corn silage, 1892	76.	77.9	36.6	73.3	77.8	78.5	80.9
CCXXVII—Field Corn fodder, 1893	69.8	71.4	54.5	70.4	72.3	71.3	67.3
CCXXXIII—Field Corn Fodder, 1893	69.7	73.6	20.	68.6	70.7	76.7	73.7

THE DIGESTIBILITY OF CORN FODDER AND CORN SILAGE AS COMPARED WITH OTHER CATTLE FOODS.

During the past four years sixteen different samples of corn fodder and silage have been made the subject of thirty-seven digestion trials at the Maine Experiment Station. These trials have included three varieties of corn both as partially dried fodder and as silage, coming from four years crops excepting in the case of the sweet corn. Further repetition of this work ought not to be necessary in order to establish safe digestion co-efficients for use in Maine feeding practice. The averages of the entire number of trials are for each variety of corn as follows:

TABLE XX.

AVERAGE COEFFICIENTS OF DIGESTIBILITY AS FOUND AT THE MAINE EXPERIMENT STATION.

	Dry matter.	Organic matter.	Ash.	Protein N×6.25.	Fiber.	Nitrogen-free-extract.	Fat.
Southern Corn fodder, 3 samples, 6 trials	65.2	66.8	45.1	62.3	71.5	65.0	66.2
Southern Corn silage, 2 samples, 6 trials	63.8	66.0	31.5	55.7	70.2	65.5	66.5
Field Corn fodder, 4 samples, 9 trials	70.8	73.1	41.9	65.4	76.2	73.3	70.0
Field Corn silage, 3 samples, 8 trials	74.3	76.7	30.0	64.7	76.9	78.3	81.4
Sweet Corn fodder, 3 samples, 6 trials	67.1	69.7	35.6	64.1	73.8	68.2	76.9
Sweet Corn silage, 1 sample, 2 trials	68.1	70.1	31.9	54.0	71.1	71.8	83.5
Timothy hay (average 10 (Maine) samples)	57.0	58.0	37.0	48.0	53.0	63.0	57.0
Wheat bran, average 2 samples	59.0	63.0	-	76.0	-	66.0	73.0
Corn meal*	87.0	-	-	60.0	-	92.0	92.0

* General average.

These figures show beyond question that corn fodder well preserved and corn silage have a high digestibility as compared with hay. To this fact should be attributed in large measure, undoubtedly, the great favor with which the corn plant, as now preserved in the silo, is regarded by dairymen as milk producing food. What has been supposed by many to be due to the peculiar influence of the fermentations in the silo, should more properly be credited to the superior food properties of the plant which the silo conserves so efficiently, and which would be equally valuable when preserved as completely in any other manner.

COMPARATIVE DIGESTIBILITY OF MAINE FIELD CORN AND THE LARGE SOUTHERN WHITE CORN.

There appears to be a marked difference in the digestibility of these two varieties of corn, which were grown under entirely similar conditions as to climate, location and manuring, the former being allowed to mature and the latter cut before silking. The following figures are sufficient evidence of this and show that the advantage is greatly with the smaller variety.

TABLE XXI.

COMPARATIVE DIGESTIBILITY OF TWO VARIETIES OF CORN.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn fodder and silage, 7 samples, 17 trials	72.3	74.6	36.8	65.1	76.5	75.5	74.9
Southern Corn fodder and silage, 5 samples, 12 trials	64.6	66.5	39.7	59.6	71.0	65.2	66.3
Difference in favor of the Field Corn	7.7	8.1	-	5.5	5.5	10.3	8.6

The observations on which the above comparison is based are too numerous and too nearly a unit in the evidence which they furnish to allow a chance of doubting the significance of the figures. It is certainly a matter of some importance to Maine farmers that the smaller variety of corn which matures in this latitude, should prove to be more digestible to the extent of about eight per cent of the total dry matter.

The nitrogen-free-extract appears to show a greater difference of digestibility than any other portion of the plant and it is here that we must look for at least a partial explanation of the fact under discussion.

Repeated reference has already been made to the much larger percentage of highly digestible carbohydrates in the mature Maine field corn as compared with the immature Southern corn. This fact must certainly largely account for the superior digestibility of the former. Several examinations of the feces in these experiments have failed to show the presence of sugars or starch, the diastase test being employed for the latter. These carbohydrates being entirely soluble in the digestive fluids, as it was reasonable to expect, their presence in these foods in greatly varying quantities must certainly cause corresponding variations in the digestibility of the nitrogen-free-extract, and consequently of the total dry matter, other things being equal.

That this is so, is easily seen from the figures presented in Table XXII.

TABLE XXII.

DIGESTIBILITY OF NITROGEN-FREE EXTRACT.

		In 100 parts dry substance.						
	Dry substance fed daily—grams.	Per cent starch and sugars.	Per cent total nitrogen-free-extract.	Starch and sugars digested daily—grams.	Nitrogen-free-extract, other than starch and sugars digested daily—grams.	Per cent starch and sugars digested.	Per cent nitrogen-free-extract digested, other than starch and sugars.	Per cent total nitrogen-free-extract digested.
SILAGE.								
CLXX—Southern Corn silage....	337.5	3.70	46.64	12.5	90.4	100.	62.4	65.4
CLXXI—Field Corn silage	437.7	18.32	59.3	80.2	135.6	100.	75.5	83.1
CLXXIII—Field Corn silage......	408.	17.43	57.9	71.1	114.5	100.	69.3	78.5
CORN FODDER.								
CCXXVII—Field Corn, immature, Sheep 1....................	701.	11.70	46.6	82.	155.6	100.	63.6	72.7
CCXXVII—Field Corn, immature, Sheep 3.................. ..	701.	11.70	46.6	82.	150.2	100.	61.4	71.1
CCXXVII—Field Corn, immature, Sheep 4.........................	701.	11.70	46.6	82.	147.7	100.	60.4	70.3
CCXXXIII—Field Corn, mature, Sheep 1	689.	31.87	63.3	219.6	92.2	100.	51.	77.9
CCXXXIII—Field Corn, mature, Sheep 3	689.	31.87	63.3	219.6	80.7	100.	44.7	75.5
CCXXXIII—Field Corn, mature, Sheep 4	689.	31.87	63.3	219.6	88.	100.	48.7	76.7

THE DIGESTIBILITY OF THE PENTOSE CARBOHYDRATES.[*]

W. E. STONE AND W. J. JONES.

[†]During the past five years attention has frequently been called to the occurrence, in many vegetable materials, of the pentosans, the term being applied to those carbohydrate-like bodies, which, upon hydrolysis produce the pentatomic sugars, arabinose or xylose, as the case may be. The presence of pentosans may be recognized by heating the materials with moderately concentrated hydrochloric or sulphuric acid, when furfurol is formed and may be detected in the vapors by the intense red color produced upon test paper freshly moistened with anilin acetate. This reaction is very sensitive and may be obtained, almost without exception, from all vegetable substances. So far as is at present known furfurol is, under these conditions, produced only from the pentose carbohydrates, with the exception of the rare glucuronic acid and its derivatives. The above mentioned test has therefore come to be regarded as a specific one, and its wide application seems to justify the statement that the pentosans are common constituents of vegetable substances. Upon closer examination it has also been found that many food materials contain the pentosans in very appreciable quantities, and it becomes desirable therefore to know something of their food value and digestibility. The ordinary food analysis, however, quite ignores these bodies except to classify them indiscriminately with all the other soluble non-nitrogenous compounds under the general term "nitrogen-free-extract matter." It is only within a short time, that any analytical method has existed which permits a separate estimation of these bodies. Such methods are now known in two or three modifications, any of which are capable of showing conclusively and with considerable accuracy, the presence of the pentosans under all conditions. It has therefore become possible to

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[*] This article is extracted from Agricultural Science Vol. VII, No. 1, p. 6.

[†] These extracts are reprinted in this connection partly because of the importance of the results and partly to give added prominence and emphasis to investigation of this sort. Our knowledge of the constitution and properties of many food compounds is sadly deficient, and the most pressing need of to-day in the line of animal nutrition is work of the kind which Dr. Stone and his associates have done in studying the carbohydrate group. Investigations of this class will be potent in shaping future knowledge and will be quoted long after many of the so called practical experiments are buried in a heap of rubbish. W. H. J.

obtain some idea as to the digestibility of these bodies by including these methods among the analytical processes controlling an ordinary digestion experiment.

One of us has already published the results of a brief digestion experiment with rabbits, from which it appeared that in a normal ration about sixty per cent. of the pentosans were digested It was also noticed that the proportion of pentosans to the entire amount of nitrogen-free-extract was much increased in the fæces as compared with the food. These results, however, being based upon meagre data, had little more than a suggestive value, as showing the importance of further study in the same direction. The present paper adds a considerable amount of proof to the previous one without materially changing the conclusions then drawn.

Some months since, Professor W. H. Jordan, Director of the Maine Experiment Station, placed at our disposal a large number of control samples of the food and fæces from digestion experiments, carried on by him during a series of years. These samples had been carefully preserved in air-tight vessels and reached us in excellent condition. We have determined the pentosans in these samples and from the feeding data furnished us by Professor Jordan, we are enabled to report upon their digestibility in twenty different experiments. . . . . The errors . . . . . of the analytical methods and of the assumption upon which the calculations are based, are all such as to minimize the actual results. In the same direction, we have presented here the lowest results obtained from duplicate determinations in each case. The data, here given indicate, therefore, the minimum amounts of pentosans found, so that the results of future study and perfected methods will, we believe, emphasize rather than diminish the conclusions here drawn.

The materials used in the digestion experiments were in part, selected samples of single species of grasses grown for the purpose at the Maine Experiment Station, and the samples were typical of our forage grasses. It is of preliminary interest, therefore, to mark the extent to which the pentosans occur in these and other materials of common and frequent use as cattle foods.

The furfurol (i. e. pentosans) was determined in each sample in duplicate by separate distillations. The lowest of these results was then multiplied by the factor 1.38 to convert it into a value representing pentosans. For comparison, the percentages of nitrogen-free-extract matter as given in Professor Jordan's report, are repeated here. All numbers relate to the dry matter.

	Per ct. furfural.		Per cent pentosans (a×1.38).	Per cent N-free-extract.
	a.	b.		
LXXXVI Phleum pratense, in early bloom.........	11.34	11.45	15.65	51.94
LXXXVII Phleum pratense, 10 days after bloom ..	11.72	11.83	16.17	55.51
CXIX Phleum pratense, early cut	9.79	9.85	12.59	46.50
CXX Phleum pratense, late cut......................	10.34	10.91	14.26	51.11
CXL Timothy hay; chiefly Phleum pratense	8.33	8.48	11.50	50.17
CLXI Same; another selection	8.88	8.94	12.25	50.16
LXXXVIII Danthonia Spicata	8.87	9.63	12.24	52.07
LXXXIX Argrostis Vulgaris	9.62	9.62	13.27	53.43
XCVI Calamagrostis Canadensis, in bloom.........	7.83	8.06	10.81	45.25
XCVII Triticum repens...	8.39	8.72	11.58	52.94
CXXVIII Hay of Hungarian grass	9.93	10.23	13.70	47.52
XC Trifolium hybridum	6.41	7.90	8.85	44.39
CXXV Field Corn fodder	11.93	12.05	16.46	52.45
LXXXIII Southern Corn fodder...	8.35	8.57	11.52	46.09
CXXXIII Sugar beets	7.48	8.16	10.32	77.31
CXXX Rutabagas............	5.99	6.11	8.26	71.29
CXXXIV Gluten meal....	4.46	4.70	6.15	52.60
XCII Fancy middlings.................................	6.79	7.02	9.37	64.18
XCI Wheat bran..................................	8.68	9.15	11.88	60.28
CXXXV Wheat bran, another selection	11.56	11.63	15.95	58.93

These results are quite confirmatory of those previously given, showing the presence of appreciable amounts of these bodies in all of these common food materials. The grasses make the largest showing, but in the majority of samples the pentosans amounted to from twenty to thirty per cent of the non-nitrogenous extractive matter.

Accompany the above samples were corresponding samples of the fæces of the animals employed in the digestion experiments, duplicated in each case. We have determined the amount of pentosans in each of these and from the gross weights of the food consumed and fæces excreted have calculated in the usual way the digestibility of the pentosans in question. These digestion experiments were conducted under the usual precautions and control, all of which, together with the analytical data, have been published in Professor Jordan's reports. The animals experimented upon were sheep in each case. . . . . . Summarizing the results of the preceding experiments, we have the following oversight of the twenty materials studied:

	Per cent of pentosans digested.
LXXXVI Phleum pratense, early bloom	60.4
LXXXVII Phleum pratense, late cut	62.8
CXIX Phleum pratense, early bloom	54 6
CXX Phleum pratense, late cut	48.2
CXL Timothy hay (chiefly Phleum pratense)	48.0
CXLI Timothy hay (chiefly Phleum pratense	49.5
LXXXVIII Danthonia spicata	68.6
LXXXIX Agrostis vulgaris	70.0
XCVI Calamagrostis Canadensis	90.4
XCVII Triticum repens	59.9
CXXVIII Hungarian grass	68.2
XC Trifolium hybridum	56.8
CXXV Fodder of field corn	76.6
LXXXIII Fodder of Southern field corn	69.6
Timothy hay, CXL, and sugar beets	71.3
Timothy hay, CXL, rutabagas	57.1
Timothy hay, CXLI. and wheat bran	45 6
Timothy hay, CXLI, gluten meal	59.1
Hay of Agrostis vulgaris, LXXXIX, and wheat bran,	54 1
Hay of Agrostis vulgaris, LXXXIX, wheat middlings,	64.9

The average of these various results, excluding the data for Calamagrostis Canadensis, which evidently present something anomalous, shows 58.2 per cent of pentosans to have been digested and 41.8 per cent undigested.

These results are worthy of consideration. Twenty of the best known food stuffs for cattle are here shown to contain a minimum of from 6-16 per cent of their dry weight in pentosans, of which an average of only 58.2 per cent is found to be digestible. It appears then, that while these bodies are to be for the present classified among the carbohydrates, they are really much less digestible, and hence of less food value, than the better known members of this group, such as starch, sugar, etc. In many cases the indicated digestibility is even less than that assigned to the fibre of the same materials and the average of all the experiments is but little higher than the corresponding average for the fibre. Indeed from the data at hand it would appear that of all the food constituents capable of individual estimation, these are among the less soluble in the digestive fluids, although commonly included among those substances which are regarded as in a high degree digestible.

Not only do the pentosans seem to be of low digestibility, but according to Ebstein, the pentoses derived from them by hydrolysis (arabinose and xylose) are little, if at all assimilated, although readily soluble. He has lately shown that the pentose sugars even in very small quantities are not assimilated by the human organism. Xylose taken in doses of less than one dram by healthy persons, could be recognized in the urine after two or three hours, and hence the use of these sugars even by healthy and much more by diabetic persons could yield no beneficial results. In this connection it is of interest to remember that the pentoses are also nonfermentable. As regards their physiological behavior, they are evidently quite distinct from the hexoses, although otherwise resembling them in chemical characteristics. It is not surprising, therefore, that the less soluble mother substance the pentosans, should also prove less digestible than other carbohydrates. In the light of Ebstein's observations, there is, moreover, good reason for believing that even such portions of the pentosans as are dissolved in the digestive tract are, after all, not assimilated.

Chemical Laboratory, Purdue University, November, 1892.

SUMMARY.

(1) A study of the digestibility of the whole corn plant shows it to have a high percentage digestibility as compared with hays and other coarse fodders, especially when allowed to develop to maturity. Of ten samples of Timothy hay, 57 per cent of the dry matter has proved to be digestible, while of Flint corn fodder (whole plant, mature) 71 per cent was digested.

(2) The mature Flint corn has proved to be more digestible than the immature Dent corn, the relation for all trials of fodder and silage being as 72 : 65.

(3) This large difference of digestibility of the two varieties of corn as harvested in Maine is undoubtedly due to the greater proportion of fiber in the Dent corn and to the larger relative amount of entirely digestible sugars and starch in mature Flint corn. This

is shown in part by the fact the excess of digestibility of the latter variety falls largely upon the nitrogen-free extract.

(4) Dr. Stone's investigations of samples of foods and fæces from digestion experiments conducted at this Station show that the pentosans (vegetable gums) were present in all the foods studied, and were digested from 45 per cent to 76 per cent. Dr. Stone observes that there is good reason for believing that even such portions of the pentosans as are dissolved in the digestive tract are, after all, not assimilated.

DATA PERTAINING TO DIGESTION EXPERIMENTS.

TABLE XXII *a*.

COMPOSITION OF THE FECES.

	In 100 parts of dry matter.				
	Ash.	Protein, N×6.25.	Fiber.	Nitrogen-free-extract.	Fat.
CXLVII—Southern Corn fodder, Sheep 1.... ..	10.56	11.32	27.84	48.04	2.24
Sheep 3.......	11.45	13.46	25.45	47.30	2.35
CXLVI—Field Corn fodder, Sheep 1.....	11.38	14.69	23.43	47.34	3.14
Sheep 3...........	11.16	15.89	22.01	48.41	2.53
CXLVIII—Sweet Corn fodder, Sheep 2.........	11.98	14.06	23.70	47.34	2.92
Sheep 4.........	11.54	14.27	23.02	48.55	2.62
CLXX—Southern Corn silage, Sheep 1, 2, 3, 4...	11.83	12.35	27.84	45.37	2.51
CLXXI—Field Corn silage, Sheep 1, 2, 3, 4......	15.33	14.67	21.30	45.53	3.17
CLXXIII—Field Corn silage, Sheep 1, 3.......	12.48	11.34	21.40	51.62	3.16
CLXXIV—Barley Hay, Sheep 1, 2, 3, 4...........	10.25	11.72	29.68	43.90	4.45
CCXXXIII—Field Corn fodder, Sheep 1.........	18.55	12.80	21.77	44.60	2.28
Sheep 3........	19.43	12.92	20.56	44.46	2.63
Sheep 4........	18.62	14.15	19.84	44.88	2.51
CCXXVII—Field Corn fodder, Sheep 1...... ...	13.15	14.32	24.91	44.91	2.71
Sheep 3..........	15.45	14.87	23.82	42.78	3.08
Sheep 4..........	13.57	14.65	24.21	44.83	2.74

CALCULATIONS OF DIGESTION CO-EFFICIENTS.

TABLE XXIII.

DIGESTIBILITY OF SOUTHERN CORN FODDER.

SHEEP 1.	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fats.
Southern Corn fodder, CXLVII.							
1,500 grams air-dry fodder daily.....	739.5	685.1	54.05	90.57	237.0	342.6	15.2
Not eaten..............................	139.5	131.4	8.3	10.80	61.8	56.7	2.0
Amount eaten daily	600.0	553.7	45.7	79.77	175.2	285.9	13.2
Excreted in fæces daily.............	231.8	207.2	24.5	26.2	64.5	111.3	5.2
	368.2	346.5	21.2	53.57	110.7	174.6	8.0
Digested, per cent	61.2	62.6	46.2	67.2	63.2	61.1	60.6
SHEEP 3.							
1,500 grams air-dry fodder fed daily.	739.5	685.1	54.0	90.6	237.0	342.6	15.2
Not eaten	65.9	61.6	4.3	4.8	28.6	27.4	.8
Amount eaten daily	673.6	623.5	49.7	85.8	208.4	315.2	14.4
Excreted in fæces daily..............	259.8	230.0	29.7	34.6	66.2	122.9	6.1
Digested............................	413.8	393.5	20.0	51.2	142.2	192.3	8.3
Digested, per cent..	61.4	63.1	40.2	59.7	68.2	61.0	57.7
Average	61.3	62.8	43.1	63.4	65.7	61.0	59.0

TABLE XXIV.

DIGESTIBILITY OF FIELD CORN FODDER.

SHEEP 1.	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extractive matter.	Fat.
Field Corn Fodder, CXLVI.							
1,500 grams air-dry fodder daily	1,003.5	940.4	62.6	122.6	306.6	491.0	20.3
Not eaten	153.3	143.8	9.7	12.5	60.5	68.3	2.3
Amount eaten daily	850.2	796.6	52.9	110.1	246.1	422.7	18.0
Excreted in feces daily	232.8	206.2	26.5	34.2	54.6	110.2	7.3
Digested	617.4	590.4	26.4	75.9	191.5	312.5	10.7
Digested, per cent	72.6	74.1	50.0	68.9	77.8	73.9	59.4
SHEEP 3.							
1,500 grams air-dry fodder fed daily.	1,003.5	940.4	62.6	122.6	306.6	491.0	20.3
Not eaten..........	160.1	149.5	10.5	14.8	61.1	71.3	2.4
Amount eaten daily	843.4	790.9	52.1	107.8	245.5	419.7	17.9
Excreted in feces daily..............	228.2	202.8	25.3	36.2	50.3	110.5	5.8
Digested.	615.2	588.1	26.8	71.6	195.2	309.2	12.1
Digested, per cent	72.9	74.3	51.4	66.4	79.5	73.7	70.0
Average	72.7	74.2	50.7	67.6	78.6	73.8	64.7

TABLE XXV.

DIGESTIBILITY OF SWEET CORN FODDER.

SHEEP 2.	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Sweet Corn Fodder, CXLVIII.							
1,500 grams air-dry fodder daily	907.5	850.2	57.1	126.7	251.7	442.1	29.8
Not eaten	111.1	101.9	9.2	9.6	42.4	48.4	1.6
Amount eaten daily	796.4	748.3	47.9	117.1	209.3	393.7	28.2
Excreted in feces daily	248.0	218.2	29.7	34.9	58.8	107.1	7.2
Digested	548.4	530.1	18.2	82.2	150.5	186.6	21.0
Digested, per cent	68.8	70.8	38.0	70.2	71.9	72.8	74.5
SHEEP 4.							
1,500 grams air-dry fodder daily	907.5	850.2	57.1	126.7	251.7	442.1	29.8
Not eaten	46.3	42.1	4.1	4.6	18.2	18.9	.6
Amount eaten daily	861.2	808.1	53.0	122.1	233.5	423.2	29.2
Excreted in feces daily	231.8	205.0	26.8	33.1	53.3	112.5	6.0
Digested	629.4	603.1	26.2	89.0	180.2	310.7	23.2
Digested, per cent	73.1	74.6	50.0	72.8	77.3	73.4	79.6
Average	70.9	72.7	44.0	71.5	74.6	73.1	77.0

TABLE XXVI.

DIGESTIBILITY OF SOUTHERN CORN SILAGE.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Southern Corn Silage, CLXX.							
2,500 grams silage daily	337.5	309.7	27.7	42.2	100.7	157.4	9.4
Excreted daily	120.3	105.9	14.3	14.8	33.5	54.5	3.0
Amount digested	217.2	203.8	13.4	274.0	67.2	102.9	6.4
Per cent digested	64.4	65.8	48.2	64.8	66.7	65.4	67.8

DIGESTIBILITY OF FIELD CORN SILAGE.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Silage, CLXXI.							
10,630 grams silage daily	437.7	412.6	25.1	44.2	92.8	259.6	15.9
Excreted daily	96.2	81.4	14.7	14.1	20.5	43.8	3.0
Amount digested	341.5	331.2	10.4	30.1	72.3	215.8	12.9
Per cent digested	78.0	80.2	41.3	68.1	77.9	83.1	80.9

TABLE XXVII.

DIGESTIBILITY OF FIELD CORN SILAGE.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Silage, CLXXIII.							
2,000 grams fed daily	408.0	388.7	19.3	41.7	94.4	236.3	16.3
Excreted daily	98.2	85.9	12.3	11.1	21.0	50.7	3.1
Digested	309.8	302.8	7.0	30.6	73.4	185.6	13.2
Per cent, digested	76.0	77.9	36.6	73.3	77.8	78.5	80.9

DIGESTIBILITY OF BARLEY HAY.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Barley Hay, CLXXIV.							
675 grams fed daily	576.2	534.7	41.5	77.1	173.7	267.1	16.6
Not eaten	19.0	17.8	1.2	2.4	5.7	9.2	.4
Consumed daily	557.2	516.9	40.3	74.7	168.0	257.9	16.2
Excreted daily	216.7	194.5	22.2	25.4	64.3	95.1	9.6
Digested	340.5	322.4	18.1	49.3	103.7	162.8	6.6
Per cent, digested	59.1	62.3	44.8	65.2	61.7	63.3	40.5

TABLE XXVIII.

DIGESTIBILITY OF FIELD CORN FODDER (MATURE).

SHEEP 1.	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Fodder, CCXXXIII.							
850 grams fed daily	689.0	639.8	49.2	72.7	147.4	400.2	19.6
Excreted daily	198.3	161.5	36.8	25.4	43.2	88.4	4.5
Digested	490.7	478.3	12.4	47.3	104.2	311.8	15.1
Per cent digested	71.2	74.8	25.2	65.1	70.7	77.9	77.0
SHEEP 3.							
850 grams fed daily	689.0	639.8	49.2	72.7	147.4	400.2	19.6
Excreted daily	220.0	177.4	42.8	28.4	45.3	99.9	5.8
Digested	468.8	462.4	6.4	44.3	102.1	300.3	13.8
Per cent digested	68.1	72.3	13.0	60.9	69.3	75.5	70.5
SHEEP 4.							
850 grams fed daily	689.0	639.8	49.2	72.7	147.4	400.2	19.6
Excreted daily	206.5	168.0	38.4	29 2	40.9	92.6	5.2
Digested	482.5	471.8	10.8	43.5	106.5	307.6	14.4
Per cent digested	70.0	73.8	21.9	59.8	72.2	76.9	73.6
Average	69.7	73.6	20.0	68.6	70.7	76.7	73.7

TABLE XXIX.

DIGESTIBILITY OF FIELD CORN FODDER (IMMATURE).

SHEEP 1.	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free-extract.	Fat.
Field Corn Fodder, CCXXVII.							
850 grams fed daily	701.0	635.6	65.4	104.9	185.8	326.6	18.3
Excreted daily...	198.0	172.0	26.0	28.3	49.3	89.0	5.3
Digested...........................	503.0	463.6	39.4	76.6	136.5	237.6	13.0
Per cent digested	71.7	72.9	60.2	72.9	73.4	72.7	70.6
SHEEP 3.							
850 grams fed daily	701.0	635.6	65.4	104.9	185.8	326.6	18.3
Excreted daily	220.6	186.6	34.1	32.8	52.5	94.4	6.8
Digested	480.4	449.0	31.3	72.1	133.3	232.2	11.5
Per cent digested	68.6	70.7	48.1	68.7	71.7	71.1	62.9
SHEEP 4.							
850 grams fed daily	701.0	635.6	65.4	104.9	185.8	326.6	18.3
Excreted daily........................	216.0	186.8	29.3	31.6	52.3	96.9	5.7
Digested.......................	485.0	448.8	36.1	73.3	133.5	229.7	12.6
Per cent digested	69.2	70.6	55.2	69.8	71.8	70.3	68.4
Average per cent digested...........	69.8	71.4	54.5	70.4	72.3	71.3	67.3

CORN AS A SILAGE CROP.

W. H. Jordan.

The report of the Station for 1891, pp. 41-46 gives a summary of three years work in testing the relative production of food material by various fodder and root crops. It appeared that the large variety of corn known as Southern White produced the greatest amount of digestible dry substance per acre, excelling root crops, Hungarian grass and other varieties of corn. Since 1891 a comparison between varieties of corn has been continued. This has been done because this crop is an important one to Maine dairymen and because the problems connected with its growth in Maine are local in their nature and cannot be solved by experiments in other states, excepting possibly, New Hampshire and Vermont.

The most common question asked in this connection is, Which are the most profitable varieties to grow, the large, which mature only in a latitude south of New England or the smaller which complete their growth in this climate?

As set forth in the report previously mentioned, the proper test of productiveness is the yield of digestible dry matter, the gross weight of crop or even of total dry matter being deceptive because of differences on the water content and in the digestibility. All effort has been directed, then, towards ascertaining the actual growth of digestible material in the several cases. One other point has necessarily been considered, viz: the relative value of a pound of digestible material in the crops compared. This latter comparison can most safely be made by a feeding experiment and this has been the method used. The study of the corn crop has been conducted in 1892 and 1893 in much the same manner as in previous years only somewhat more comprehensively.

The data recorded in succeeding pages have been obtained,

(1) By weighing the green crop as harvested.

(2) By immediate drying of the green product to ascertain the dry matter.

(3) By analysis of the dry matter to determine its composition.

(4) By a partial chemical study of the nitrogen-free-extract.

(5) Digestion experiments with sheep.

All this work centers around two problems: First, the relative yield of digestible dry matter in immature Southern Dent corn and in mature Maine field corn; and second, the influence of maturity on the amount and kind of product.

Weight of Green Product. This was ascertained by cutting the whole field, and hauling to the barn and weighing as fast as cut.

Determination of Dry Matter. Several hundred pounds carefully selected from the several rows of each plot were cut by the horse power fodder cutter, thoroughly mixed, from which a large sample was taken for drying in a steam closet.

Chemical Analysis. These results have been described in previous pages. The ordinary analysis was by the methods of the A. O. A. C.

Digestion Experiments. These trials have been carried on either with the partially dried fodder or with the silage made from it. The detailed results of these experiments have been previously given.

Manuring and Method of Planting. 1892. Field No. 1. Size one acre, soil, a loam, somewhat lighter than clayey loam, shading towards sandy. Summer fallowed in 1891 to kill witch grass. About six cords of stable manure and a fertilizer consisting of four hundred pounds dissolved bone black, one hundred pounds muriate of potash, and seventy-five pounds nitrate of soda, applied in spring. Planted in rows three and one-half feet apart, with kernels six inches apart in drills. Level, clean culture. Planted May 19th, harvested September 6th to 9th.

Field No. 2. Size, one acre, soil, clayey loam. Planted to corn in 1891. About seven cords of stable manure and the same amount and kind of fertilizer as on Field No. 1, applied in spring. Culture and planting same as Field No. 1. Planted May 19th, harvested September 6th-9th.

1893. Field No. 1, same as in 1892. About six cords of stable manure and five hundred pounds of Bay State fertilizer, applied in spring. Planting and culture as 1892. Planted May 31st, harvested September 14th to 16th.

Field No. 2, same as in 1892. Manuring, planting and culture same as Field No. 1. Planted May 31st, harvested September 14th to 16th.

In both fields, during both years, each acre was divided into twenty plots, the two kinds of corn alternating, ten plots being devoted to each. It is scarcely possible to secure conditions more uniform in which to compare the growth of two crops than existed in these experiments.

The results secured are concisely stated in Table XXX, all intermediate data such as size of plots and yield per plot, being omitted. The figures for the three years previous are stated for the sake of comparison.

TABLE XXX.

COMPARATIVE YIELD OF SOUTHERN CORN AND MAINE FIELD CORN, AS GROWN IN MAINE—YIELD PER ACRE.

	Green corn, (whole plant)—pounds.	Dry substance.		Digestible dry substance.	
		Per cent.	Pounds.	Per cent.	Pounds.
Crop of 1888.					
Southern Corn	26,295	12.30	3,234.3	65	2,102.3
Maine Field Corn	14,212	17.4	2,472.9	70	1,720.5
Crop of 1890.					
Southern Corn	32,950	14.94	4,922.7	69	3,396.7
Maine Field Corn	15,300	15.84	2,415.9	71	1,715.3
Crop of 1891.					
Southern Corn	46,340	13.46	6,237.4	61	3,804.8
Maine Field Corn	28,080	13.55	3,804.8	73	2,777.5
Crop of 1892.					
Southern Corn, Field 1	37,320	14.67	5,474.8	64	3,503.9
Field 2	34,820	14.15	4,927.0	64	3,153.2
Maine Field Corn, Field 1	22,490	20.90	4,700.0	78	3,666.0
Field 2	29,400	18.64	5,480.0	76	4,164.8
Crop of 1893.					
Southern Corn, Field 1	39,066	15.45	6,036.7	* 65	3,923.2
Field 2	26,660	16.58	4,420.2	* 65	2,873.1
Maine Field Corn, Field 1	27,780	25.43	7,064.4	70	4,945.0
Field 2	18,610	19.50	3,628.9	70	2,540.2
Southern Corn, 7 trials.					
Maximum	46,340	16.58	6,237.4	69	3,923.2
Minimum	26,295	12.30	3,234.3	61	2,102.3
Average	34,761	14.50	5,036.0	65	3,251.0
Maine Field Corn, 7 trials.					
Maximum	29,400	25.43	7,064.4	78	4,945.0
Minimum	14,212	13.55	2,415.2	70	1,715.3
Average	22,269	18.75	4,224.0	73	3,076.0

* The average of previous years.

The foregoing figures show a large variation in production in different years, under conditions other than the season, quite uniform. This variation is not alone in gross weight of crop, but in dry matter as well The largest quantity of dry matter produced in any case during five years is nearly three times that yielded by the smallest crop. This is due in part to the manuring and cultivation and in part to the character of the season.

Had these experiments been discontinued after 1891 the outcome would have been decidedly favorable to the large variety of Dent corn. but in 1892 and 1893, the relation of yield has been reversed and the smaller variety of Flint corn has taken the lead. It is probable that another five years' series of comparisons would furnish a somewhat similar experience.

The general outcome for the five years is slightly favorable to the large variety of corn if we consider only the yield of digestible dry matter. But when we take account of the fact that in the one case an average of five and one-half tons more of material have annually been handled over several times, we are led to conclude that the smaller, less watery variety of corn has really proved the more profitable.

It is significant, also, that the largest yield of dry matter in any instance has been from the smaller variety. While the Flint corn grown in this State is not capable of producing so much dry substance as the large variety of Dent corn, under circumstances equally favorable for both, the former cannot in this latitude reach anything like maturity, and so loses the advantage of that period when growth is most rapid, as subsequent figures show.

The writer has made one or two observations during these five years which may be worth noting. One is that the cut worm scarcely ever molests the large Dent corn, even when feeding freely on the smaller Flint variety. This fact was observed during two years. It is also the writer's opinion, from observation, that conditions unfavorable as to fertility and cultivation will reduce the growth of the Maine corn to the greater extent.

A condensed summary of the results which are the outcome of this series of experiments, appears below. These statements stand somewhat in conflict with those of the 1891 report. It must be remembered, however, that the honest experimenter is limited in his conclusions to the facts which appear after a careful analysis of data. Facts should always outweigh existing opinions. Such a rule of action often requires a reversal of former conclusions. This experience may be unfortunate but is not blameworthy.

(1) The average weight per acre of the green crops for five years were: Southern corn, 34,761 pounds; Maine field corn, 22,269 pounds; difference, 11,492 pounds, or nearly five and three-fourths tons.

(2) The average dry matter per hundred pounds was nearly one-third more in the Maine field corn, the relation being: Southern corn 14.50 pounds; Maine field corn 18.75 pounds, or as 100:129.

(3) The Maine field corn proved to be more digestible, the relation for dry matter being: Southern corn, 65; Maine corn, 73, or as 100:112.

(4) The average pounds of digestible dry matter per hundred pounds of green corn have been: Southern corn 7.25 pounds; Maine field corn 13.69 pounds, or as 100:189.

(5) The average yield of dry matter per acre has been: Southern corn 5,036 pounds,—extremes, 7,064 pounds and 2,415 pounds.

(6) The average yield of *digestible* dry matter has been: Southern corn 3,251 pounds,—extremes 3,923 pounds and 2,102 pounds; Maine field corn 3,076 pounds,—extremes 4,945 pounds and 1,715 pounds.

(7) The yield of digestible dry matter has averaged 175 pounds more per acre with the Southern corn. To offset this it has been necessary to handle annually five and three-fourths tons more weight.

(8) The largest as well as the smallest yield of digestible dry matter in a single year has been furnished by the Maine field corn.

THE INFLUENCE OF MATURITY UPON THE VALUE OF THE CORN CROP FOR FODDER OR SILAGE PURPOSES.

There have existed, without doubt, some very erroneous notions in regard to the relative value of the corn crop at different stages of growth. Corn that is thickly planted and cut when quite immature is so easily masticated and is eaten with such evident relish, that such material has by many been regarded more highly than the facts warrant. Correct views prevail to a greater extent than formerly, partly because several careful experiments, the results of which have been widely published, show that the plant continues to increase its store of dry substance until full maturity and that this growth is very rapid during the last stages of development.

It was understood, therefore, that an experiment along this line would be to an extent a repetition. Nevertheless for several reasons it was thought best to do this. In the first place an unusually good opportunity was offered to secure uniform conditions as to soil. Again, the outcome whatever it might be would be a more valuable object lesson to Maine farmers than results reached in some other state. Finally, it was desired to learn something as to the nature of the growth which is so rapid at approaching maturity.

The field of corn selected for studying the influence of maturity was the one designated as Field No. 1 (1893). The corn was of very uniform growth, being finely eared and in every way satisfactory for experimental purposes.

Each of the ten plots consisted of five rows, and it was decided to harvest one-fifth of the crop or one-tenth of an acre at each of five periods of growth. cutting one row of each plot at each period. As in other similar experiments, quite an amount of each lot was finely chopped, and a portion of this was immediately dried in a steam closet.

TABLE XXXI.

PRODUCTION OF THE CORN PLANT AT DIFFERENT STAGES OF GROWTH.

Date of cutting and condition of crop.	Days in each period of growth.	Yield of green corn per acre.	Dry substance.		Gain in weight in e'ch period, dry matter—lbs.	Rate of gain per day—dry matter—lbs.
			Per cent in crop.	Total yield per acre—lbs.		
August 15th, ears beginning to form		26,166	11.71	3,064.0		
August 28th, a few roasting ears	13	29,777	17.50	5,210.9	2,146.9	165.0
Sept. 4th, all roasting ears...........	7	31,000	19.55	6,060.5	849.6	121.3
Sept. 12th, some ears glazing.......	8	28,833	23.17	6,680.6	620.1	77.5
Sept. 21st, All ears glazed............	9	27,777	25.34	7,039.7	358.1	39.8
Total increase after August 15th	-	-	-	-	3,974.7	

The results of this experiment certainly furnish a striking illustration of the folly of harvesting immature corn for silage purposes whenever it is possible to allow it to attain maturity.

In this instance, the quantity of dry matter in the corn at maturity was nearly two and one-half times greater than at the silking period thirty-seven days previous, the average rate of increase per acre of dry substance being about 108 pounds daily. This daily increase is equivalent in quantity to one day's ration for four or five cows of ordinary weight.

The character of this growth has been clearly set forth on previous pages, in discussing the analyses of these samples of corn fodder. The facts that appear can be emphasized, however, by a display of the quantities of the different classes of nutrients found to exist at the different periods of growth.

The figures in Table XXXII are the results of applying the foregoing analyses to the total yield of dry matter

TABLE XXXII.

PRODUCTION OF DIFFERENT CLASSES OF COMPOUNDS BY THE CORN PLANT AT DIFFERENT STAGES OF GROWTH.

	Ash.	Protein, Nx6.25.	Fiber.	Nitrogen-free-extract.	Sugars.	Starch.	Fat.
August 15th, ears beginning to form*	285.9	458.4	812.3	1,428	358.5	-	79.7
August 28th, a few roasting ears	338.7	611.7	1,214.0	2,892	1,064.0	108	153.7
September 4th, all roasting stage....	376.3	689.6	1,192.0	3,621	1,248.0	297	181.8
September 12th, some ears glazing..	372.4	639.5	1,291.0	4,177	1,407.0	357	200.4
September 21st, all ears glazed......	416.1	649.8	1,309.0	4,457	1,161.0	1,083	208.4
Gain after August 15th...............	130.2	191.4	496.7	3,029	802.5	1,083	128.7
Gain after August 28th	77.4	38.1	95.0	1,565	97.0	975	54.7

*The manner of drying the sample taken from the lot cut at this period may have caused a loss of sugar.

From August 15th to August 28th there appears to have been considerable growth of the compounds of all classes, but after that date the increase of dry matter was due chiefly to the formation of one class of compounds. After August 28th, and until September 21st, the total growth was 1,828 pounds of dry matter, 1,565 pounds of which, or all but 263 pounds, belonged to the nitrogen-free-extract. Of this 1,565 pounds, 1,072 pounds consisted of sugars and starch. Two facts are clearly shown: First, that the later growth of dry matter in the corn plant is made up chiefly of non-nitrogenous compounds; and second, a large percentage of these compounds consisted of sugars and starch, substances that are the best of their class for the purposes of animal nutrition.

Feeding Experiments.

W H. JORDAN.

There are two methods of judging the value of cattle foods. In common parlance one would be styled "scientific" and the other "practical." Both may be correctly classed as scientific or as practical according to the manner in which they are carried out and the standpoint from which they are regarded. Certainly if a conclusion is reached through truly scientific means it must have an entirely practical application, and no conclusion can be safely applied to the management of a business, which has not been reached in a way that is essentially scientific.

The two methods by which we may study a cattle food in trying to estimate its value, are: First, determine its composition and digestibility and then from known principles and the facts determined derive an opinion as to the place this food will take in stock feeding; and second, to feed this food to a given class of animals, under conditions as definite and as well controlled as possible, note the apparent results, and base a conclusion upon these. The conclusions should be the same by both methods provided that on the one hand it is possible to find out not only the amounts but the nutritive office of all the compounds which the food contains, and that on the other hand, perfect control and knowledge of every factor involved in a feeding experiment can be secured. In neither case are we now able to realize a satisfactory standard of work, and so in comparing the two methods it is only a question of which one can be so carried out as to be entitled to the greater degree of confidence.

Of course the ultimate appeal must in a general way always be to the animal, and the strongest conclusions are those supported both by theoretical considerations and actual results.

A question may arise, however, where from the standpoint of the chemist a clear answer is given, which answer is not ratified by the results of a feeding experiment, as to which is at present the more reliable basis of judgment, the knowledge gained by a chemical study of the food, or the apparent outcome of an actual feeding trial. For instance, it is desired to compare the feeding value of bran and fine middlings. The composition of the two is found not to differ greatly so far as it is a question of the relative amounts of the several classes of compounds, and the digestibility of the former is found to be much less than that of the latter. These facts regarded in the light of approved theories, warrant the conclusion that the feeding value of the middlings is the greater. But a feeding trial in which rations, containing in some periods bran and in others, middlings, are compared, either does not show the expected difference, or declares one altogether larger than other facts seem to warrant. Are we, then, to conclude the theory is wrong? Certainly not from a single trial. So many conditions, such as the lengthening of the period of lactation, the temperature of the barn, variations in weight due to a change in intestinal contents, and the unreckoned or unmeasured increase or decrease of the flesh of the animal (if with cows), enter into a feeding trial as unknown factors, that such differences as exist between two grain foods may either be covered up or greatly exaggerated. Nothing short of several feeding trials should be allowed to throw a doubt upon the correctness of theories that appear to be well substantiated by severe methods of investigation, and even then the points of disagreement would, doubtless, be regarded as unsettled questions.

Fortunately, however, the value to farm practice of the feeding trials here reported is not lessened by apparent discrepancies between the outcome which general principles would seem to dictate and the results actually reached. The experiments which are discussed in this connection are the following:

(1) The relative feeding value of Southern corn silage and Maine field corn silage.

(2) The influence of widely differing rations upon the quantity and composition of milk.

(3) Experiments with swine.

(*a*) Relative economy of production with different breeds.

(*b*) The market value of different breeds.

(*c*) The comparative value of nutrients from skimmed milk and from vegetable foods.

(*d*) The economy of production at different ages.

FEEDING EXPERIMENTS WITH COWS.

THE RELATIVE FEEDING VALUE OF SOUTHERN CORN SILAGE AND MAINE FIELD CORN SILAGE.

The discussion on previous pages of the comparative compositio and digestibility of Southern corn and Maine field corn, makes plai three facts:

1st. The Maine Corn contains less water or more dry matte than the other.

2nd. The dry matter of the Maine Field Corn is the more digestible of the two kinds.

3rd. This difference is due to the formation in the Maine Fiel Corn, while maturing, of compounds that are wholly digestible an of the highest nutritive value.

These facts as plainly declare as facts can that the one variety o corn is worth much more than the other in feeding value, if equa weights are compared. Can this be shown in practice? Will th animal ratify the conclusion that the digestible dry matter, whe judging foods of the same class, is a safe standard of comparison What is the influence of maturity on the value of the digestibl dry matter as shown by experience?

These questions as related to silage corn were submitted to th test of a feeding experiment for milk production in the winter o 1892-3. The plan of the experiment was a simple one. It wa divided into three periods, of about one month each, the only essential changes in the rations of the several periods being a substitutio of one kind of silage for the other. It was intended to supply th same quantity of digestible material from each of the two kinds o silage. This was not done, however, because it was not possible t ascertain the actual composition and digestibility of these material until during the time they were being fed, and more digestibl dry substance was consumed in the Maine Field Corn Silage tha in the other. The data noted in this experiment include:

(1) The weights of food consumed.

(2) The composition and digestibility of the foods.

(3) The weights of water drank.

(4) Variation of the live weights of the cows. (The cows wer weighed on three successive days of each week.)

(5) The yield of milk. (Each mess of milk was weighed.)

(6) The composition of the milk. (Each mess of milk was analyzed for five successive days during the last week of each period.)

From the facts supplied by such a collection of data it was hoped to derive evidence of a somewhat decisive character, so far as this can be accomplished by a single experiment. These data are displayed in the several tables of figures which follow.

RATIONS.

Period 1.	Nov. 21st to Dec. 18th,	14 pounds Barley Hay. 40 pounds Southern Corn silage (No.CLXX). 6 pounds grain mixture.
Period 2.	Dec. 19th to Jan. 18th,	14 pounds Barley Hay. 30 pounds Maine Field Corn silage (No. CLXXI). *6 pounds grain mixture.
Period 3.	Jan. 19th to Feb. 16th,	12 pounds Timothy Hay. 40 pounds Southern Corn silage (No. CLXXVI). *6 pounds grain mixture.

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* The cow Nancy Avondale was fed 7 pounds grain mixture.

TABLE XXXIII.

COMPOSITION OF FOODS.

	Dry matter.	Digestible material.		
		Organic matter.	Protein.	Carbo-hydrates.
	%	%	%	%
Southern Corn silage, CLXX*.. ..	13.5	8.3	1.10	6.8
Southern Corn silage, CLXXVI*.. .	16.2	10.0	1.70	7.8
Field Corn silage, CLXXI	22.3	16.8	1.50	14.7
Barley Hay*........................	85.37	50.3	7.4	40.6
Timothy Hay........................	87.50	48.2	3.33	42.9
Corn meal	89.4	77.3	8.0	65.4
Bran..............................	88.5	51.8	13.2	34.8
Gluten meal	90.4	78.9	22.9	48.7
Cotton seed meal	91.8	68.5	36.8	17.9

* The composition and digestibility of these foods were actually determine
For the other foods average figures were used.

TABLE XXXIV.

NUTRANTS IN DAILY RATIONS,—(POUNDS).

		Dry matter.	Total organic matter.	Protein.	Carbo-hydrates.
*First period		22.7	14.23	2.47	11.15
*Second period........		24.0	16.00	2.47	12.84
*Third period.		22.4	14.00	2.07	11.02
Nancy Avondale	Second period.....	24.9	16.7	2.63	13.3
	Third period...	23.2	14.5	2.23	11.4

* The same for all cows except Nancy Avondale.

TABLE XXXV.

WATER DRANK DAILY.

	Agnes—pounds.	Dins.—pounds.	L. T.—pounds.	Shaw—pounds.	N. A.—pounds.
First period	52.4	56.8	48.1	53.0	
Second period	51.4	56.5	48.0	51.9	65.6
Third period	45.9	48.9	45.7	40.8	57.4

TABLE XXXVI.

WEIGHTS OF THE COWS.

FIRST PERIOD.	Agnes.	Dins.	L. T.	Shaw.	N. A.
First week	*870	867	836	965	
Second week	870	853	831	958	
Third week	863	843	834	955	
Fourth week	861	850	840	945	
Average	866	853	835	956	
SECOND PERIOD.					
First week	845	847	821	938	990
Second week	837	832	816	929	990
Third week	834	830	823	946	987
Fourth week	833	832	820	946	986
Average	837	835	820	940	988
THIRD PERIOD.					
First week	843	843	830	963	965
Second week	852	845	835	976	958
Third week	838	841	837	959	955
Fourth week	840	845	833	952	945
Average	843	843	834	962	956

* Each number represents the average of three weighings.

TABLE XXXVII.

MILK YIELD,—POUNDS PER WEEK.

	N. A.	Agnes.	Dins.	L. T.
November 27th to December 18th, inclusive, 22 days.				
First week		185.4	181.4	175.9
Second week		176.3	177.5	170.1
Third week		174.3	174.7	166.1
Last day		26.5	24.6	25.3
Total yield		562.4	558.3	537.4
Average daily yield		25.6	25.3	24.4
December 25th to January 18th, inclusive, 25 days.				
First week	246.3	172.6	169.5	173.0
Second week	239.9	176.5	177.4	175.8
Third week	236.7	172.3	175.6	164.7
Last four days	138.9	98.0	99.1	98.6
Total yield	861.7	619.4	621.6	612.2
Average daily yield	34.5	24.8	24.9	24.5
January 22d to February 16th, inclusive, 26 days.				
First week	224.0	159.0	167.7	172.7
Second week	225.0	158.5	162.0	167.4
Third week	214.1	153.4	157.6	164.5
Last five days	151.3	106.4	108.9	112.5
Total yield	814.4	577.4	596.3	617.1
Average daily yield	31.3	22.2	22.9	23.7

TABLE XXXVIII.

AVERAGE DAILY YIELD OF MILK.

	Agnes. Pounds.	Dins. Pounds.	L. T. Pounds.	Shaw. Pounds.
First period, Nov. 27th to Dec. 18th—22 days	25.6	25.3	24.4	20.1
Second period, Dec. 25th to Jan. 18th—25 days	24.8	24.9	24.5	19.8
Third period, Jan. 22d to Feb. 16th—26 days	22.2	22.9	23.7	18.3

TABLE XXXIX.

AVERAGE COMPOSITION OF FIVE DAYS' MILK IN EACH PERIOD.

	Agnes.		Dins.		L. T.		Shaw.		N. A.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%
First period..........	13.44	4.4	14.02	4.5	12.99	3.9	14.22	4.8		
Second period............	14.09	4.8	14.56	4.9	13.84	4.4	15.16	5.4	12.05	3.2
Third period..............	14.02	4.9	14.68	5.1	13.46	4.4	14.72	5.3	11.66	3.0

TABLE XL.

DAILY YIELD OF MILK SOLIDS,—POUNDS.

	Agnes.	Dins.	L. T.	Shaw.	N. A.	Average.
First period	3.43	3.55	3.17	2.85	-	3.24
Second period....................	3.49	3.62	3.39	3.00	4.15	*3.37
Third period..	3.11	3.37	3.19	2.69	3.65	*3.09

* N. A. not included in these averages.

TABLE XLI.

POUNDS DIGESTIBLE FOOD EATEN FOR EACH POUND MILK SOLIDS PRODUCED.

	Agnes.	Dins.	L. T.	Shaw.	N. A.	Average.
First period	4.16	4.00	4.49	4.99	-	4.41
Second period	4.58	4.42	4.72	5.33	4.02	*4.79
Third period.......	4.50	4.15	4.39	5.20	4.00	*4.56

* Averages, excluding N. A.

It appears that in the first two feeding periods fourtee
pounds of barley hay and mixed grain were fed besides the silag
and that in the third period twelve pounds of Timothy hay took th
place of the barley hay. Forty pounds of Southern corn silag
were fed in the first and last periods and thirty pounds of Fiel
corn silage in the middle or second period. The daily digestib
food for each of the three periods was 14.23 pounds, 16 pound
and 14 pounds respectively, so that the substitution of thirty pound
of Maine field corn silage for forty pounds of Southern corn silag
had the effect of increasing the daily composition of digestible mat
rial by nearly two pounds. The fact that the daily ration of diges
ible material did not remain practically the same in all periods
introduces an element of uncertainty into the conclusions whic
may be drawn.

The relative effect of these rations must be seen, if at all, b
studying their effect upon the bodily condition of the animals an
upon the production of milk. If we do this we find that th
cows lost from fifteen to thirty pounds weight in passing from th
first to the second periods and that this loss was partially regaine
during the third period. These changes in live weight can b
readily explained by the less weight of silage eaten in the secon
period, with no marked change in the quantity of water drank in an
period.

Ordinarily in an experiment of this kind, extending through thre
months or more, there is a gradual but continuous decrease in th
volume of the milk yield, unless there is a change in the food favo
able to an increased milk production. When we see that in th
second period of this experiment practically the same weight o
milk was produced, and that owing to an increase in the dry matte
of the milk there was actually a larger production of milk solids
we have good presumptive evidence that the ration containing th
thirty pounds of Field corn silage was more efficient than the pre
vious ration containing forty pounds of Southern corn silage. Thi
evidence is strengthened by the fact that when in the third period
return is made to the Southern corn silage the yield of milk solid
is decidedly diminished. Nevertheless, as stated in the preliminar
discussion of feeding experiments, minor differences in two rations
such as existed in this experiment are not easily measured where s
many uncontrolled and unmeasured factors exist.

The best possible analysis of the evidence that is secured in this case seems, however, to be entirely in favor of the conculsion that pound for pound the Maine Field Corn Silage was worth more than the Southern Corn silage, and that the difference was practically in the proportion of the amount of digestible dry substance in the two materials. This is the result which a careful consideration of the facts learned in other ways would lead us to expect.

THE INFLUENCE OF WIDELY DIFFERING RATIONS UPON THE QUANTITY AND QUALITY OF MILK.

There is no question more generally discussed by dairymen just at this time than the influence of the food of a cow upon the amount and kind of milk. It is agreed on all sides that the quantity of milk is up to a certain limit very largely dependent upon the quantity and kind of food. Many farmers also express themselves as convinced that the quality of milk is materially modified by the kind of food, and so we hear such expressions as "feeding for milk" and "feeding for butter," as though a ration that will cause an increased flow of milk will not necessarily increase the butter production.

The opinion largely held by agricultural chemists and others who regard this question in the light of the results of experiment and investigation, is that the quality of milk is practically controlled by the individuality of the animal and that within the limits of healthful feeding the composition of the milk is not to be greatly influenced by the kind of food. It is conceded that marked changes occur in the milk of the same animal, such as daily variations, and variations due to protracted lactation, changes of season, weather and other causes not well defined. The fat in the milk may differ one per cent on two successive days, without apparent cause, although at other times a reasonable explanation may appear. The fact that when cows are fed each day exactly the same quantity of the same kind of food the milk does not remain constant in composition, but varies to a material extent, furnishes an element of uncertainty in interpreting the results of those feeding experiments which have for their object a study of the influence of food upon milk. It is not always easy to become satisfied that any change in the milk is due to a known cause.

Many experiments have been carried on for the purpose of throwing light upon the problem here presented, and while the testimony is largely on one side, it is to some extent conflicting. Up to th present date, however, the concensus of opinion is as before stated that the animal is the determinative factor. There are numerou facts in common experience which accord with this opinion. Ever farmer recognizes marked differences in the milk of the severa animals in his herd and he is well aware that by no sort of manipulation of food can he obliterate these differences and reduce th milk of all his different animals to a dead level of quality. Whatever practice he may adopt in feeding he will still have "poor-milk cows and "rich-milk" cows. It is a matter of common observatio that certain breeds furnish milk of a characteristic quality and n one has yet discovered a way of converting a Jersey's milk into th kind the larger and more showy Holstein yields, neither do we kno how to coerce the latter into supplying us with the richness of colo and composition which we have imported from the Channel Islands It is reasonable to regard lactation as a function, which, both as t the kind and the maximum quantity of the product, is fixed chiefl by the constitutional limitations of the individual.

It has been supposed possible for changes in the food to cause th composition of the resulting milk to vary in two ways, viz : by increasing or decreasing the percentage of solid matter, and by changin the composition of the solids, as for instance, increasing the fa without a corresponding increase of casein.

The experiment with cows, the results of which are given in thi connection, was planned with reference to changes in the rations s radical as to induce if possible corresponding variations in the character of the milk. The attempt was not to compare a starvatio diet with liberal feeding, because no one believes a starvation ratio to be wise or profitable, and liberal feeding is universally regarded as a part of the creed of successful agriculture. But while there is a general agreement that the ration should be generous in quantit and agreeable in quality, there is much discussion as to the way i which this ration should be compounded and the relative effcet o different mixtures of the nutrients, and so the rations in this experiment were made to differ very widely in the relation of the nitrogenous to the non-nitrogenous nutrients.

The experiment was begun with four cows, one of which was dropped out and results are reported from only three. The three feeding periods covered one hundred and five days, or thirty-five days each.

The three cows were designated as A, R, and L. T. The two rations compared were as follows:

RATION 1.

Timothy hay	ad lib.
Corn meal	2 pounds.
Cotton-seed meal	2 pounds.
Gluten meal	2 pounds.

RATION 2.

Timothy hay	ad lib.
Corn meal	6 pounds.

Ration 1 was fed to A during the first and third periods, and to R and L. S. during the second or middle period. Ration 2 was fed to A in the middle period and to R and L. S. in the first and third periods.

A record was made of the food consumed and of the weights of milk produced. During the last five days of each period the milk was analyzed. The butter was also submitted to tests for melting points, the percentages of volatile acids and for the iodine absorption equivalent.

The data are all given in the subsequent tables.

TABLE XLII.

FOOD EATEN.

Period 1.	Period 2.	Period 3.
	Cow A.	
804 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal.	740 lbs. Timothy hay. 210 lbs. corn meal.	750 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal
	Cow R.	
777 lbs. Timothy hay. 210 lbs. corn meal.	770 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal.	710 lbs. Timothy hay. 210 lbs. corn meal.
	Cow L. T.	
777 lbs. Timothy hay. 210 lbs. corn meal.	770 lbs. Timothy hay. 70 lbs. corn meal. 70 lbs. gluten meal. 70 lbs. cotton-seed meal.	680 lbs. Timothy hay. 210 lbs. corn meal.

AVERAGE WEIGHTS OF COWS,—POUNDS.

	Cow A.	Cow R.	Cow L. T.
First period	876	859	866
Second period	872	853	837
Third period	846	840	831

TABLE XLIII.

DAILY RATIONS IN TERMS OF DIGESTIBLE NUTRIENTS,—POUNDS.

PERIOD 1.	Cow 1.	Cow 2.	Agnes.
Dry substance	24.8	24.8	25.5
Organic digestible matter	15.3	15.3	15.6
Digestible protein	1.21	1.21	2.1
Digestible carbohydrates	13.4	13.4	12.5
Digestible fats	.64	.64	.8
Nutritive ratio	1: 12.3	1: 12.3	1: 6.8
PERIOD 2.			
Dry substance	24.7	24.7	23.8
Organic digestible matter	15.1	15.1	14.8
Digestible protein	2.09	2.09	1.1
Digestible carbohydrates	12.07	12.07	12.9
Digestible fat	.84	.84	.6
Nutritive ratio	1: 6.7	1: 6.7	1: 12.3
PERIOD 3.			
Dry substance	23.1	22.3	24.1
Digestible organic matter	14.4	14.	14.8
Digestible protein	1.15	1.13	2.0
Digestible carbohydrates	12.62	12.24	11.8
Digestible fats	.81	.60	.8
Nutritive ratio	1: 12.3	1: 12.00	1: 6.6

TABLE XLIV.

YIELDS OF MILK.

Period 1. (December 12th to January 15th inclusive.)

	Cow A. Nitrogenous ration.—pounds.	Cow R. Corn meal ration.—pounds.	Cow L. T. Corn meal ration.—pounds.
First week	172.0	126.5	128.7
Second week	185.9	114.2	120.8
Third week	182.0	128.5	128.0
Fourth week	183.2	106.6	116.4
Fifth week	190.6	108.7	112.9
Total for last four weeks	741.7	458.1	478.0
Average per day	26.5	16.4	17.4

Period 2. (January 16th to February 19th inclusive.)

	Cow A. Corn meal ration.—pounds.	Cow R. Nitrogenous ration.—pounds.	Cow L. T. Nitrogenous ration.—pounds.
First week	175.4	120.2	117.3
Second week	151.8	149.1	139.7
Third week	146.0	149.8	135.6
Fourth week	133.2	141.6	130.2
Fifth week	129.3	146.1	128.6
Total for last four weeks	560.2	580.6	534.2
Average per day	20.0	20.7	19.1

TABLE XLIV—Concluded.

Period 3. (February 20th to March 25th inclusive.)

	Cow A. Nitrogenous ration.—pounds.	Cow B. Corn meal ration.—pounds.	Cow L. T. Corn meal ration.—pounds.
First week	154.4	124.1	114.0
Second week	176.8	108.1	110.5
Third week	172.5	106.3	100.7
Fourth week	172.4	95.4	98.9
Fifth week	169.3	84.0	87.8
Total for last four weeks	691.0	393.8	397.9
Average per day	24.7	14.1	14.2

SUMMARY.

	Cow A. Pounds.	Cow B. Pounds.	Cow L. T. Pounds.
Average total yield on nitrogenous ration	716.4	580.6	534.2
Average total yield on corn meal ration	560.2	425.9	437.9
Excess of yield with nitrogenous ration	156.2	154.7	96.3
Daily yield with nitrogenous ration	25.6	20.7	19.1
Daily yield with corn meal ration	20.0	15.2	15.6
Daily excess with nitrogenous ration	5.6	5.5	3.5

TABLE XLV.

COMPOSITION OF THE MILK.

		Total solids. %	Casein and albumen. %	Fat. %
Cow A.,	First period, nitrogenous ration.	14.06	3.76	4.70
	Second period, corn meal ration,	13.39	3.45	4.24
	Third period, nitrogenous ration	14.17	3.51	4.74
Cow R.,	First period, corn meal ration....	13.26	3.47	4.07
	Sec'nd period, nitrogenous rat'n,	13.92	3.67	4.77
	Third period, corn meal ration..	14.03	3.38	4.84
Cow L. T.,	First period, corn meal ration...	13.38	3.48	3.99
	Sec'nd period, nitrogenous rat'n,	14.27	3.67	4.72
	Third period, corn meal ration..	13.62	3.12	4.55

TABLE XLVI.

YIELD OF MILK SOLIDS.

		In 28 days.	In one day.
Cow A.,	First period, nitrogenous ration	104.3 pounds	3.72 pounds
	Second period, corn meal ration	75.0 pounds	2.68 pounds
	Third period, nitrogenous ration	97.9 pounds	3.50 pounds
Cow R.,	First period, corn meal ration	60.7 pounds	2.17 pounds
	Second period, nitrogenous ration	80.8 pounds	2.88 pounds
	Third period, corn meal ration	55.3 pounds	1.97 pounds
Cow L. T.,	First period, corn meal ration...........	63.9 pounds	2.28 pounds
	Second period, nitrogenous ration.......	76.2 pounds	2.72 pounds
	Third period, corn meal	54.2 pounds	1.93 pounds

SUMMARY.

	Cow A.	Cow R.	Cow L. T.
	Pounds.	Pounds.	Pounds.
Av. daily yield milk solids on nitrogenous ration,	3.61	2.88	2.72
Av. daily yield milk solids on corn meal ration..	2.68	2.07	2.10
Excess with nitrogenous ration................	.93	.81	.62

TABLE XLVII.

RELATION IN QUANTITY OF THE COMPOUNDS OF THE MILK.

Cow A.	Relation of casein to fat. Casein=100.	Relation of fat to total
First period, nitrogenous ration	100:125	100
Second period, corn meal ration	100:123	100
Third period, nitrogenous ration	100:135	100
Cow R.		
First period, corn meal ration	100:117	100
Second period, nitrogenous ration	100:130	100
Third period, corn meal ration	100:143	100
Cow L. T.		
First period, corn meal ration	100:115	100
Second period, nitrogenous ration	100:129	100
Third period, corn meal ration	100:146	100

TABLE XLVIII.

BUTTER CHARACTERISTICS.

Cow A.	Melting point. C°.	Volatile acids.
First period, nitrogenous ration	33.2	32.9
Second period, corn meal ration	34.0	29.9
Third period, nitrogenous ration	33.1	30.1
Cow R.		
First period, corn meal ration	34.0	32.6
Second period, nitrogenous ration	33.2	31.4
Third period, corn meal ration	34.2	32.8
Cow L. T.		
First period, corn meal ration	31.1	33.2
Second period, nitrogenous ration	29.3	30.7
Third period, corn meal ration	30.0	30.8

The foregoing data, which as stated, are the result of an attempt to study the influence of widely varying rations upon the production and characteristics of milk, give conclusive evidence in regard to but one of the several points considered. The figures tabulated give information about,

(1) The total and digestible food consumed.

(2) The body weights of the animals.

(3) The milk yield.

(4) The composition of the milk.

(5) The yield of milk solids.

(6) The composition of the milk solids.

(7) Certain chemical and physical characteristics of the butter fat.

A review of these data warrant the following summary:

(1) Milch cows were fed two rations differing widely in the amount of protein which they contained. The hay was the same in both, also the weight of grain, but in one the grain consisted wholly of corn meal while in the other it was made up of cotton-seed, gluten and corn meals in equal parts.

(2) Both rations furnished practically the same amount of digestible material. The proportion of digestible protein was nearly twice as great in the mixed grain ration as in the corn meal ration.

(3) The cows did not vary greatly in body weight, but their general appearance showed less thrift while being fed the corn meal ration.

(4) The yield of milk from the nitrogenous ration was from one-fifth to more than one-third larger than that from the corn meal ration, the excess ranging with the three cows from 20 per cent to 36 per cent, or an average of about five pounds of milk per day.

(5) In general the milk was materially richer while the cows were fed the ration rich in protein, though with one cow it showed the largest percentage of solids during the third period while she was eating the corn meal ration. With the other two cows the influence of the mixture of cotton-seed meal, gluten meal and corn meal in increasing the per cent of solids of the milk seemed quite marked.

(6) The daily yield of milk solids was from thirty to forty per cent greater with the more nitrogenous ration.

(7) The composition of the milk solids seemed to be independent of the ration. In general the proportion of fat increased throughout the experiment without regard to what the cows were fed, and no evidence is furnished in support of the notion that by changing the food it is possible to produce more butter fat withou an accompanying increased production of the other milk solids In other words, it appears that the most profitable food for butte production will also be most profitable for the milk farmer o cheese maker. The relation of fat to the other solids seems to b determined by the animal or by certain unknown conditions o environment rather than by the food.

(8) So far as could be learned by chemical tests, the butte made from the two rations was not greatly different.

FEEDING EXPERIMENTS WITH SWINE.

More or less experimental feeding with swine has been going o at the station since the last report that was made of similar wor in 1890. These experiments have been practical rather than scientific, and have not resulted as satisfactorily in all respects as wa desired. They have centered chiefly around two main considerations: First, the relative economic value of several breeds o swine, special attention being paid to the Tamworths, and to cross of this breed with the Berkshire; second, the relative valu of the dry matter of skimmed milk and an equivalent amount o digestible material from some nitrogenous vegetable food.

The Tamworth swine used as a basis of these experiments were fine pair of these animals presented to the station by J. M. Sears Esq., of Boston, Mass., to whom the station is greatly indebted The female has produced several litters of pigs, and certain of thes have been used in the feeding tests. Crosses have also been secure by the use of the Tamworth male and Berkshire females, and a will be seen by the results obtained, these animals have proved t be desirable.

Three lots of animals have been grown from young pigs to marketable condition. The first lot included Cheshires, Jerse Reds and White Chesters, the second lot Tamworths and Tamworth-Berkshires, and the third lot Tamworths, Berkshires an Tamworth-Berkshires.

The first lot lived mostly in pens out of doors, having shelter from inclement weather. The other lots were grown in indoor pens.

A careful record of food consumed and weights of animals was kept. The food was weighed daily and the animals once a week.

The foods were not analyzed, but are assumed to have the average composition, which for milk and grains may be safely regarded as involving only a small error.

By the use of the figures given in Jenkins' and Winton's tables, and of digestion co-efficients selected from American and German work, the following percentages of digestible material are found to be contained in the food used in these experiments, and these percentages have been applied in calculating the digestible organic nutrients actually consumed.

TABLE XLIX.

COMPOSITION OF FOODS USED IN FEEDING EXPERIMENTS WITH SWINE.

	Dry matter in 100 pounds.	Digestible nutrients in 100 pounds.			
		Total organic matter.	Protein.	Carbo-hydrates.	Fats.
Corn meal	89.4	80.8	8.8	74.3	3.85
Fancy middlings	89.3	67.3	12.0	53.6	3.2
Gluten meal	90.4	82.5	25.3	49.8	4.85
Mangolds*	11.7	9.0	.93	8.1	.12
Oats (ground)	89.0	60.2	9.1	47.2	4.15
Pea meal	89.5	79.2	17.8	59.4	.59
Skimmed milk	10.0	9.2	3.5	5.2	.5
Sugar beets*	16.2	15.0	1.42	13.4	.07

* Actual analyses were made of these materials.

In the tables which succeed, may be found a statement of the results of these experiments.

TABLE L.

EXPERIMENT OF 1891 WITH SWINE.

	White Chester.	Jersey Red.	Cheshire.
Number of animals	2	2	1
Days fed	140	157	157
Skimmed milk consumed*	1800	1884	1256
Middlings consumed	1056	1123	663
Total dry matter consumed	1123	1191.2	717.6
Digestible protein consumed	189.7	200.7	123.5
Digestible carbohydrates consumed	659.5	699.9	420.7
Digestible fats consumed	42.8	45.3	27.5
Total digestible matter consumed, (organic)	892.0	945.9	571.7
Dry matter consumed daily	4.01	3.79	4.57
Digestible organic matter consumed daily	3.18	3.01	3.64
Initial weight of pigs	129	114	82
Last weight of pigs	449	437	265
Total gain of pigs	320	323	183
Daily gain of pigs	1.15	1.03	1.16
Digestible organic matter eaten per pound of gain	2.78	2.93	3.12

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* All figures representing weights are in pounds.

TABLE LI.

EXPERIMENT OF 1891-2.

Early Growth of Tamworths and Tamworth-Berkshires.

	Lot 1. Skimmed milk with grain.		Lot 2. Grain ration, no milk.	
	Tamworth pigs.	Tamworth-Berkshire pigs.	Tamworth pigs.	Tamworth-Berkshire pigs.
Number of animals	2	3	2	2
Days fed	126	98	126	98
Skimmed milk consumed	2,506	2,184		
Corn meal consumed	211.0	273.0	254.5	
Sugar beets consumed	422	-	427	
Mangolds consumed	-	294	-	196
Gluten meal consumed	-	-	254.5	
Peas consumed	-	-	-	182.5
Oats consumed	-	-	-	182.5
Dry matter consumed	507.7	496.8	527.5	348.5
Dry matter consumed daily	2.01	1.69	2.09	1.78
Digestible protein consumed	112.3	103.3	92.5	51.1
Digestible carbohydrates consumed	328.2	319.3	354.4	210.2
Digestible fats consumed	20.9	21.5	22.4	8.9
Digestible organic matter consumed	461.4	444.1	469.3	270.2
Digestible organic matter consumed daily	1.85	1.52	1.90	1.39
Initial weight of pigs	73.0	81.0	75.0	53.0
Last weight of pigs	217.0	260.0	199.0	132.0
Total gain of pigs	144.0	179.0	124.0	79.0
Daily gain per pig	.57	.61	.48	.40
Digestible organic matter eaten for each pound of gain	3.18	2.48	3.78	3.42

TABLE LII.

EXPERIMENT 1891-2, (Continued).

Later, Growth Tamworths, and Tamworth-Berkshires.

	Lot fed more skim-milk.	Lot fed less skim-milk.
Number of animals	2	2
Days fed	148	148
Skimmed milk consumed	4,116	2,058
Corn meal consumed	1,435	1,435
Pea meal consumed		147
Oat meal consumed		147
Dry matter consumed	1,694.5	1,750.9
Dry matter consumed daily per pig	5.72	5.91
Digestible protein consumed	271	238.7
Digestible carbohydrates consumed	1,175.4	1,225.1
Digestible fats consumed	75.8	72.5
Digestible organic matter	1,522.2	1,536.3
Digestible organic matter fed daily per pig	5.15	5.20
Initial weight of pigs	208	218
Last weight of pigs	676	691
Total gain	468	473
Daily gain per pig	1.58	1.60
Digestible organic matter eaten per pound of gain	3.26	3.27

TABLE LIII.

EXPERIMENT 1892.

Period 1. Food, Skimmed Milk and Ground Oats.

	Tamworth.	Berkshire.	Tamworh-Berkshire.
Number of animals	4	4	4
Days fed	112	112	112
Skimmed milk consumed	1,792	1,792	1,792
Oat meal consumed	855	1,059	855
Dry matter consumed	940.1	1,108.9	940.1
Dry matter consumed daily per pig	2.10	2.46	2.10
Digestible protein consumed	140.5	157.2	140.5
Digestible carbohydrates consumed	496.8	583.6	496.8
Digestible fats consumed	43.9	52	43.9
Digestible organic matter consumed	681.2	792.8	681.2
Digestible organic matter consumed daily per pig	1.53	1.76	1.53
Initial weight of pigs	74	110	65
Last weight of pigs	397	470	400
Total gain	323	336	335
Daily gain per pig	.72	.75	.75
Digestible organic matter eaten for each pound of gain	2.11	2.36	2.03

TABLE LIII—CONTINUED.

Period 2. Food, Skimmed Milk, Pea Meal and Corn Meal.

	Tamworth.	Berkshire.	Tamworth-Berkshire.
Number of animals	4	4	4
Days fed	42	42	42
Skimmed milk consumed	672	672	672
Pea meal consumed	172.6	200.6	172.6
Corn meal consumed	345.4	401.4	345.4
Dry matter consumed	530.3	605.4	530.3
Dry matter consumed daily per pig	3.15	3.60	3.15
Digestible protein consumed	84.6	94.5	84.6
Digestible carbohydrates consumed	368.5	422.6	368.5
Digestible fats consumed	17.8	20.1	17.8
Digestible organic matter consumed	470.9	537.2	470.9
Digestible organic matter consumed daily per pig	2.80	3.20	2.60
Initial weight of pigs	399	470	400
Last weight of pigs	544	611	546
Total gain	147	141	146
Daily gain per pig	.87	.84	.87
Digestible organic matter eaten for each pound of gain	3.20	3.80	3.20

TABLE LIII—CONTINUED.

Period 3. Food, Mixture Equal Parts Pea Meal, Oat Meal and Corn Meal.

	Tamworth.	Berkshire.	Tamworth-Berkshire.
Number of animals	3	3	3
Days fed	63	49	63
Pea meal consumed	371	253	371
Oat meal consumed	371	253	371
Corn meal consumed	371	253	371
Dry matter consumed	993.0	677.8	993.0
Dry matter consumed daily per pig	5.25	4.61	5.25
Digestible protein consumed	131.4	90.3	131.4
Digestible carbohydrates consumed	643.4	439.5	643.4
Digestible fats consumed	31.3	22.	31.3
Digestible organic matter consumed	806.1	551.8	806.1
Digestible organic matter consumed daily per pig	4.27	3.77	4.27
Initial weight of pigs	438	507	439
Last weight of pigs	638	601	668
Total gain	200	94	229
Daily gain per pig	1.06	.64	1.21
Digestible organic matter eaten for each pound of gain	4.03	5.87	3.52

TABLE LIII—CONCLUDED.

Period 4. Food, Skimmed Milk, Oat Meal and Corn Meal.

	Tamworth.	Berkshire.	Tamworth-Berkshire.
Number of animals	3	3	3
Days fed	56	63	49
Skimmed milk consumed	1,680	1,890	1,470
Oat meal consumed	476.0	402.5	416.5
Corn meal consumed	476.0	402.5	416.5
Dry matter consumed	1,017.0	907.1	891.7
Dry matter consumed daily per pig	6.07	4.94	6.06
Digestible protein consumed	144.5	138.3	126.5
Digestible carbohydrates consumed	631.0	556.5	553.2
Digestible fats consumed	46.4	41.5	40.7
Digestible organic matter consumed	821.9	736.3	720.4
Digestible organic matter consumed daily per pig	4.89	4.01	4.90
Initial weight of pigs	638	601	668
Final weight of pigs	834	801	847
Total gain	196	200	179
Daily gain per pig	1.17	1.06	1.22
Digestible organic matter eaten for each pound of gain,	4.19	3.80	4.02

SUMMARY.

Number of days fed	273	266	266
Digestible organic matter consumed	2,780	2,618	2,678
Total gain	866	771	894
Digestible organic matter for each pound of gain	3.21	3.40	3.00

RELATIVE GROWTH OF ANIMALS OF THE SEVERAL BREEDS.

The only fair comparison of the economy of production with animals from the several breeds is based upon the digestible food consumed for each pound of growth. The figures showing this have been brought together from the foregoing tables and can be seen in table 54.

TABLE LIV.

RELATION OF FOOD TO GROWTH.

(Pounds digestible organic material for each pound gain.)

	Cheshire.	Poland China.	Yorkshire.	White Chester.	Jersey Red.	Berkshire.	Tamworth.	Tamworth-Berkshire.
Experiment—1890	2.88	2.73	2.60	2.50	-	2.45		
1891	3.12	-	-	2.78	2.93			
1891-2, early growth..	-	-	-	-	-	-	3.18	2.48
1891-2, later growth ..	-	-	-	-	-	-	3.71	2.89
1892, period 1.....	-	-	-	-	-	2.36	2.11	2.03
1892, period 2.........	-	-	-	-	-	3.80	3.20	3.20
1892, period 3..........	-	-	-	-	-	5.87	4.03	3.52
1892, period 4....	-	-	-	-	-	3.80	4.19	4.02
1892, av. four periods,	-	-	-	-	-	3.40	3.21	3.00

These experiments furnish no evidence of the superior producing capacity of any one of the breeds tested. It should be observed that with the exception of the Tamworths, Berkshires and the Tamworth-Berkshire cross the number of animals grown was too small to allow conclusions of much value.

It is certainly true of the Tamworth-Berkshire cross that the animals were finely formed and vigorous, and they certainly used food more economically than either the pure bred Tamworths or Berkshires. This cross has been admired by all who have seen it, and the market quality of their carcasses was highly commended.

BUTCHERS' ANALYSIS OF THE CARCASSES.

It is evident that the present demands of the market are for pork of a somewhat different kind than was the case formerly. Now the retail meat trade calls for a rather small carcass that will cut a large proportion of lean parts, and as the lean cuts bear a higher price than "clear pork" it is for the interest of both farmer and dealer that animals be grown which will supply the requirements of the market. Farmers are surely making a mistake in supposing that the fattest animals are certainly the most profitable. It is at least true that such animals tend to aggravate rather than amend the unbalanced diet to which Americans are so much given.

It was hoped that in the Tamworths would be found a breed of swine which with the use of proper rations would furnish to consumers a larger proportion of lean meat than is the case with the breeds more commonly in use, and in order to learn whether this hope would be realized a butcher's analysis has been made of the carcasses of several lots of animals, including five pure breeds and one cross. The most reliable comparison is that made between the Tamworths, Berkshires and the Tamworth-Berkshire cross. The results of this analysis can be seen in Table LV.

TABLE LV.

BUTCHER'S ANALYSIS OF THE CARCASSES.*

	Dressed weight, pounds.	Weights of separate parts,—pounds.							Per cent of lean cuts.	Per cent of salting pork.
		Hams.	Shoulders.	Spare-ribs.	Breakfast bacon.	Leaf lard.	Head and feet.	Salting pork.		
Cheshire .	200	28.5	12	50	-	11	19	-	45	
Chester	171.5	25	13	44	-	7.7	21.5	-	48	
Jersey Red	172.5	25	9	38	-	11.5	18.75	-	41.7	
Berkshire	187	26	12.5	46.2	-	8.5	20	-	45.3	
Berkshire	233	33.5	19.5	48	19	14	22.5	76.5	43.3	32.8
Berkshire	199	31.5	17.5	33	12.5	12.5	18	74.3	41.1	37.3
Berkshire	215	30.5	19.7	49	13.5	12.5	18.2	71.6	46.1	33.3
Average	-	-	-	-	-	-	-	-	43.4	34.4
Tamworth	235	33.7	22.5	58	24.5	13	23	60.3	48.6	25.6
Tamworth	281	38.5	19.5	58.6	22.5	17.7	28.5	95.8	41.4	34.1
Tamworth	236	33.5	20	51	13.2	18.2	21.2	78.9	44.3	33.4
Tamworth	227	32.5	18	47.2	15.2	15	21.2	77.9	43	34.3
Tamworth	208	30.2	18.5	44	12.7	15.2	21	66.3	44.6	31.9
Average	-	-	-	-	-	-	-	-	44.4	31.9
Tamworth-Berkshire .	341	43	24	67.5	27.5	21	27.2	130.8	39.4	38.4
Tamworth-Berkshire .	292.5	38	25.7	62.5	29.5	16.2	23	97.6	43.2	33.4
Tamworth-Berkshire .	234	29.5	20.5	49.7	12.5	16.2	18.2	87.4	42.6	37.3
Tamworth-Berkshire .	228	31	18	50	12	15	18.2	83.8	43.4	36.8
Average	-	-	-	-	-	-	-	-	42.1	36.5

* These pigs were cut up and the parts weighed by Charles York & Co., Bangor, Me., to whom the Station is greatly indebted for this service.

The above figures show the proportional amount of lean cuts in the several animals. The term "lean cuts" is taken to mean the sum of the hams and shoulders trimmed and the spare-ribs.

The data here presented do not warrant the claim that any one of the breeds compared possesses superior market qualities over all the others. The Tamworth's gave a somewhat larger percentage of lean cuts and the Tamworth-Berkshire cross a larger proportion of salting pork. The differences are small, we may believe, compared with those which may be caused by age, food, or individual variations.

THE RELATIVE VALUE OF DIGESTIBLE FOOD FROM ANIMAL AND FROM VEGETABLE SOURCES.

The report of the Maine Experiment Station for 1889 contains an account of experiments which had for their object, in part, a comparison of the dry matter of skimmed milk with the digestible part of pea meal as food for swine. Those experiments indicated a practical equivalence, pound for pound.

This matter has again been brought to a practical test in the experiments now under discussion. The growth of separate lots of pigs, selected from the same litter, and of the same lots of pigs during separate periods, has been compared when fed rations containing practically the same amount of digestible matter, but which was derived from unlike sources. As in the experiments of 1889, pea meal or oat meal was made to take the place of skimmed milk in the proportion of the digestible substance in the two.

In tables LVI and LVII are presented the figures showing the actual food required for a pound of growth.

TABLE LVI.

EXPERIMENT IN WHICH THE SKIMMED MILK WAS REPLACED BY NITROGENOUS FOODS, WHOLLY OR IN PART.

	Digestible organic food consumed for each pound of gain in live weight.		
	Tamworths.	Tamworth-Berkshires.	Mixed lot of Tamworths and Tamworth-Berkshires.
Lot 1—Growth from one to four months.			
Food, skimmed milk, corn meal and beets............	3.18	2.48	
Food, gluten and corn meal and beets..........	3.78		
Food, pea meal, oat meal and beets		3.42	
Lot 2—Growth from four to nine months.			
Food, skimmed milk* and corn meal.			3.35
Food, skimmed milk† pea meal, oat meal and corn meal			3.27

*Amount of milk daily, thirty pounds.

†Amount of milk daily, fifteen pounds. Part only of the skimmed milk was replaced by the pea and oat meals.

TABLE LVII.

EXPERIMENT IN WHICH ONE RATION CONTAINED PEA MEAL IN THE PLACE OF SKIMMED MILK IN THE OTHER RATION.

	Digestible organic food consumed for each pound of gain in live weight.		
	Tamworths.	Berkshires.	Tamworth-Berkshires.
Growth from 1 to 4½ months. (Period 1.)			
Food, skimmed milk and ground oats.........	2.11	2.36	2.08
Growth from 4½ to 6 months. (Period 2.)			
Food, skimmed milk, pea meal and corn meal.... . .	3.20	3.80	3.20
Growth from 6 to 8½ months. (Period 3.)			
Food, equal parts pea meal, oat meal and corn meal.	4.03	5.87	3.32
Growth from 8½ to over 10 months. (Period 4.)			
Food, skimmed milk, oat meal and corn meal.........	4.19	3.80	4.02

It is very plain that for young pig the rations containing skimmed milk proved superior to those containing the nitrogenous vegetable foods as a substitute. But with the older animals the substitution of pea meal or pea and oat meal for the skimmed milk, wholly or in part, did not materially change the rate of growth or its relation to the digestible food consumed.

In a single case an exception occurs, viz: Period 3 with the Berkshires in the 1892 experiment, where the pure grain ration seemed to check the growth of the pigs. In all other cases the amount of digestible food seems to be the practical measure of efficiency whether its source be animal or vegetable.

WASTE OF FAT IN SKIMMED MILK BY THE DEEP-SETTING PROCESS.*

W. H. JORDAN AND J. M. BARTLETT.

The relative economy of the various methods of creaming milk is a matter which is just now receiving much attention from Maine dairymen. The question which is most frequently asked, especially by those keeping a fairly large herd of cows, is, "Shall I get a separator?"

In comparing the separator with the cold deep-setting process several points demand consideration:

1st. The relative expenditure of money, time and labor.
2d. The relative waste in the skimmed milk.
3d. The relative waste in the buttermilk.
4th. The comparative quality of the product.

Present knowledge leads to the opinion that the cream can be handled with equal economy from the two methods, and that there is not difference enough between well made separator-cream butter and equally well made cold-setting-cream butter to find any practical recognition in the most particular market.

The first two points, then, are the ones concerning which there is still more or less discussion.

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*The matter presented under this head is prepared to be issued as Bulletin No. 3, second series.

The object of this bulletin is to present certain facts, latel ascertained by the Station, bearing upon the second point. Thes facts were obtained as follows: A representative of the Statio Mr. Hayes, during a certain part of August, September and Oct ber last, accompanied the cream collectors of two butter factorie viz: the Turner Centre Factory and the Poland Factory, on the trips to the houses of the patrons, and thoroughly sampled th skimmed milk from twenty-four hours' milk. These samples, whic were kept sweet by means of a preservative, were promptly shippe to the Station laboratory, where the per cent of fat was determine The Turner Factory patrons were visited between August 24th an September 9th, and the Poland Factory patrons, between Septem ber 30th and October 10th. Besides the names and addresses the patrons, Mr. Hayes noted other data, which, when summarize give the following figures:

No. of farms visited	224
No of cows then milked	1,360
Quarts of milk produced	7,623
No. of herds full-blooded Jerseys	6
“ “ “ grade Jerseys (occasional full-bloods,)	167
“ “ “ full-blood Holsteins	2
“ “ “ grade Holsteins	1
“ “ “ miscellaneous (mixtures of Jersey and other grades, &c.,)	52
“ “ farms using deep setting process	221
“ “ “ “ separator	1
“ “ “ “ shallow pans	2
“ “ “ with ice constantly in tanks	194
“ “ “ out of ice	16
“ “ “ using some ice	5
“ “ “ no record	6

Doubtless some will remark that neither the number of cow kept nor the yield of milk make a very favorable showing fo Maine dairymen. It should be remembered, however, that thes farms were visited at a season of the year when there would proba bly be found more dry cows and more in an advanced stage o lactation than at any other time. Besides, a severe drought ren dered the past season a particularly unfavorable one.

In regard to the methods of creaming, it appears that but on separator was found, while 221 out of the 224 farmers are using the cold deep-setting process. Of these only sixteen are recorded as being out of ice, while one hundred and ninety-four keep ice in the tanks constantly.

The very great prevalence of Jersey blood is another fact worthy of note, showing the tendency of Maine farms, not only towards dairying, but towards a specific purpose, rather than a general purpose. cow.

The prevalence of the Jerseys and the almost universal use of ice in the tanks all the time are two conditions very favorable to the best possible results with the deep setting process. The percentages of fat in skimmed milk from the 224 farms are not given here in detail, only a summary.

Farms with skimmed milk fat .1 per cent. or below... ...	41
" " " " " above .1 per cent. and not over .15 per cent.	67
" " " " " above .15 per cent. and not over .20 per cent...	57
" " " " " .25 per cent...............	19
" " " " " .30 per cent.	11
" " " " " .35 per cent............ ..	3
" " " " " .40 per cent.	6
" " " " " from .5 to .2 per cent... ..	17

Average amount of fat in 100 lbs. skimmed milk (224 farms)	.239 lbs.
Average amount of fat in 100 pounds skimmed milk excluding seventeen farms where the amount was .5 pounds or over (207 farms)...............	.182 lbs.
Average amount of fat in 100 pounds skimmed milk Turner Centre Factory (157 farms)	.188 lbs.
Average amount of fat in 100 pounds skimmed milk Poland Factory (66 farms)	.357 lbs.
Average for Turner Factory excluding 6 farms over .5 pounds.................................	.168 lbs.
Average for Poland Factory excluding 11 farms over .5 pounds........	.222 lbs.

The above figures are certainly somewhat surprising. They are much more favorable to the cold deep setting process than any heretofore published, of which the writer is aware, and somewhat diminish the argument for the separator, in so far as it pertains to the prevention of waste in the skimmed milk. One hundred and sixty-five of the two hundred and twenty-four herds tested did not excee .2 per cent. of fat in the skimmed milk, the average being about . per cent. By the use of the separator on these farms not over . per cent. fat would be saved, or one pound of butter fat to t thousand pounds of skimmed milk, *provided the deep setting proce is as successfully used all the time.* It is not claimed that the wo of the deep setting process is always as good as this. The fac are stated simply as they are found.

It appears that in seventeen cases the per cent. of skimmed mi fat ranged from .5 to 2. In many instances there appears to be sufficient cause for this excessive loss. In ten of these cases t supply of ice was exhausted, in one the breed of cows was possil not adapted to the closest deep-setting creaming, in one instan the cream was taken by "top-skimming" which may easily invol unusual loss, and in five instances the conditions were good, the being no apparent reason for abnormal waste.

IS IT NECESSARY TO SUBMERGE THE CANS?*

In the use of the Cooley tank and cans in our own private dai operations, our philosophy has not considered it necessary that t cans be submerged in order to secure the cleanest practicable crea ing, care only being taken that the iced water be kept above t height of the milk in the cans. Seeing the statement in one of o exchanges that the dairymen at the Connecticut convention jump on to the claim made by Professor Jordan, that the submerger was not absolutely necessary to good work, for they had proved the contrary, we at once applied to Professor Jordan to learn wheth experiments conducted by him had shown that we, and others f lowing the same method, were losing cream by such practice. reply he has kindly furnished data on the matter, which we give the readers of the *Farmer* for their benefit.

PROFESSOR JORDAN'S REPLY.

Two reasons are directly or indirectly put forward why subme ing should be secured:

1. The composition of the cream is more uniform when this done.

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*The following discussion of this question appeared in the *Maine Farmer* March 1st, 1894, and as it is a matter closely related to the cold setting proc for raising cream, and as the data on which the discussion is based was obtai in connection with that presented on the foregoing pages, the liberty is take reprint the *Farmer* article in this connection.

2. Less fat is left in the skimmed milk than otherwise would be the case.

No experimental evidence is at hand to show whether the first claim is in accordance with fact or not. The only possible reason that can be offered, however, why submerging affects the consistency of cream, is that it prevents evaporation and consequent thickening of the surface of the cream. But when the cans are in a closed cabinet. the air over the water must be so saturated with moisture as to preclude evaporation from the cream, even if the cans are not submerged. But this point is scarcely worth arguing, for other unavoidable conditions so influence the composition of cream as to completely overshadow this in effect.

The second claim is the more important, and concerning which a certain amount of data is fortunately available.

As was stated in Bulletin No. 5, just issued from this Station, and published in the *Farmer*, a representative of the Station visited two hundred and twenty-four farms, supplying milk to two creameries, and took samples of the skimmed milk. Among other data he noted the manner of setting the milk, whether ice was in the tanks, whether the cans were submerged or not, and if not, the depth of the water.

In making up the averages presented herewith, it should be stated that the first twenty-five farms are excluded, as no record was made of the depth of the water. There are also excluded a few cases where top skimming was practiced, because uniform conditions should prevail in such a comparison. Again, the cases where no ice was used, or other unfavorable circumstances existed, are not included. With these exceptions, the figures obtained are as follows:

Number of observations made	163
Number with cans submerged or sealed	124
Number with cans not submerged or sealed	39
Per cent skimmed milk fat in submerged or sealed cans	.173
Per cent skimmed milk fat in cans not submerged or sealed	.200

The difference is slightly in favor of submerging, but is not large enough to have any practical importance.

It is noticeable in looking over the records mentioned in the foregoing, that a greater percentage of Jerseys and Jersey grades were found among the patrons of the Turner factory than among those of the Poland factory, the latter owning a somewhat larger proportio of Shorthorn and Holstein grades. For this reason it is possibl more just to compare results among the patrons of the same factor especially as the "not submerged" cases were more frequent in or case than in the other:

TURNER FACTORY.

Number patrons with cans submerged or sealed	10
Number patrons with cans not submerged or sealed	1
Per cent skimmed milk fat in submerged or sealed cans ..	.16
Per cent skimmed milk fat in cans not submerged or sealed..	.17

POLAND FACTORY.

Number patrons with cans submerged or sealed	1
Number patrons with cans not submerged or sealed	2
Per cent skimmed milk fat in cans submerged or sealed......	.20
Per cent skimmed milk fa tin cans not submerged or sealed..	.21

The records show that where the cans were not submerged c sealed, the depth of water varied from half the height of the can t a level with the handles. Mr. Hayes states that the purpose seeme to be to have the water as high as the milk, or above.

The value of submerging as a means of decreasing the waste c fat in the skimmed milk does not become apparent through the fore going figures. It should be remembered, however, that in all thes cases ice was used and kept in the tanks all the time. If this wer not done, the chances would appear to be in favor of submerging because the greater the volume of water, the less its temperatur would be raised by cooling the warm milk.

W. H. JORDAN.

Maine Experiment Station, February 14, 1894.

REPORT OF THE HORTICULTURIST.

W. M. Munson.

Many of the experiments detailed in the following report are repetitions or continuations of those undertaken in previous years. The conclusions reached, though sometimes contradicting those heretofore drawn, are none the less valuable. They are the result of careful study of the problems, and as stated in other connections, conclusions are too often freely drawn from insufficient data.

The cauliflower has been added to the list of vegetables receiving special attention, and our success, from a practical point of view, would indicate that the crop may be profitably grown in this section of the state.

The fruit plantation is not as yet in full bearing, and notes concerning the comparative merits of varieties are reserved for a future report. Several additions were made to the orchard, also to the collection of small fruits, during the past season. Despite the cold winter of 1892-3, very little damage was noticed in our plantations.

Spraying experiments were continued on the lines detailed in my last report. The results obtained, as heretofore, point strongly to the value of the use of the copper solutions in combatting the apple scab. The most valuable preparation yet used is the Bordeaux mixture. We are under special obligations to Mr. Charles S. Pope of Manchester, for the continued use of his orchard and the careful attention given in carrying into effect the instructions of the writer.

Included in this report is a catalogue of the fruits of the state with the approximate value of each. This catalogue is presented only after careful study of the reports of many of the leading fruit growers in different sections of the state, in response to a series of questions sent out by the writer. It will be found valuable for reference in the selection of fruits for general planting.

I wish to make special mention of the careful and efficient work of my assistant, H. P. Gould.

1—Notes of Cabbages.

As heretofore our work with cabbages was confined to a few questions relative to methods of culture. In all cases the seed was sown in the forcing house April 3d, and the young plants were pricked out into boxes April 24th. The season was exceptionally late and second handling was necessary, May 17th, before the final transfe to the field May 30th.

"All Head Early" and "Burpee's Safe Crop," two sorts sent fo trial by W. Attee Burpee & Co., of Philadelphia, are of the Fl Dutch type. They did not average quite so large nor so early Early Flat Dutch, but were very uniform in size, of firm textur and produced a high percentage of marketable heads.

1. *Influence of Transplanting*: For two seasons an experime has been conducted for the purpose of ascertaining wheth plants handled in pots previous to setting in the field, are enou superior to those handled in boxes, to warrant the increas expense.* In 1891 the results were indifferent, while last ye indications were strongly in favor of the pot-grown plants. Th treatment of the plants was in every respect similar to that give last season, *i. e.* one lot of twenty-five young plants was transferre from the seed flat to three-inch and later to four-inch pots, whil a duplicate lot was placed in shallow boxes—two inches apart at th first handling and four inches apart at the second.

The results obtained are shown in table I.

TABLE I.

CABBAGE PLANTS FROM POTS AND BOXES.

VARIETY AND TREATMENT.	Heaviest head—lbs.	Lightest head—lbs.	Average weight—lbs.	Number of heads cracked.	Number of heads immature.	Failed to head.	Ratio.	Remarks.
FLAT DUTCH.								
Pots	15.2	8.9	**10.7**	3	0	0	**1.23**	All cut Aug. 1
Boxes	12.0	2.9	**8.7**	0	1	2	**1.00**	
SAFE CROP.								
Pots	10.0	5.5	**7.4**	0	0	1	**1.34**	
Boxes	9.2	2.4	**4.9**	0	11	2	**1.00**	
ALL-HEAD EARLY.								
Pots	12.0	2.8	**8.3**	1	0	0	**1.60**	
Boxes	8.0	1.1	**5.2**	0	1	0	**1.00**	

*Report Maine Experiment Station, 1891, p. 84; 1892, p. 61.

As will be seen at a glance plants handled in pots were, in every respect, superior to those from the boxes; thus confirming results obtained last year. In no case did the plants from boxes produce heads equal to the best of those from pots.

Conclusion: The practice of handling cabbage plants in pots previous to setting in the field would seem to be warranted by the results obtained during the past two seasons.

2. *Effects of Trimming*: A test as to the value of the practice of reducing the amount of foliage at time of setting was conducted along the same lines as last season.* The results as shown by table II are almost identical with those obtained in the previous trial.

TABLE II.

EFFECTS OF TRIMMING.

VARIETY.	Number of heads.	Heaviest head—lbs.	Lightest head—lbs.	Average weight—lbs.	Number of heads cracked.	Number of heads immature.	Number of plants not cut.	Ratio.	Date of harvesting.
EARLY SUMMER.									
Trimmed	9	10.0	4.0	**7.9**	4	2	1	**1.23**	Sept. 1.
Not trimmed	8	9.4	3.1	**6.4**	2	2	1	**1.00**	Sept. 1.
WORLD BEATER (Brill).									
Trimmed	7	13.3	6.9	**9.5**	1	0	1	**1.00**	Sept. 12.
Not trimmed	7	14.7	3.5	**9.5**	2	1	1	**1.00**	Sept. 12.
WORLD BEATER (Burpee).									
Trimmed	19	15.7	3.3	**9.9**	0	0	2	**1.00**	Sept. 12.
Not trimmed	13	16.0	6.2	**11.1**	3	0	1	**1.12**	Sept. 12.

As will be observed, the results are almost negative. The first variety, Early Summer, exactly reverses the result given last season, when the ratio was as 1.00:1.23 in favor of plants not trimmed. In case of World Beater (Brill) the ratio was neutral as in 1892. The plants used in this test were from the same lot of seed as those grown last year. The third variety gave results slightly in favor of plants not trimmed.

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*Report Maine Experiment Station 1892, p. 60.

Conclusion: The results of two seasons' work indicate that little advantage is derived from the practice of trimming cabbage plants at time of setting.

3. *Holding Plants in Check:* Frequently, because of an unusually late season, or from other unavoidable circumstances growers are unable to set plants in the field as soon as they might desire, or when the plants are ready for the transfer. Such conditions existed in our own experience the present year and to meet the case in hand, at the last handling in the house, May 17, all plants except some for checks were severely headed back. What the usual result might be of course we are unable to say, but indications are certainly favorable to the practice. Our general crop was uniformly good. The results of careful comparison of plants thus treated with others of the same lots not checked are given in table III.

TABLE III.

CHECKING GROWTH.

VARIETY.	Heaviest head—lbs.	Lightest head—lbs.	Average weight—lbs.	Number of heads cracked.	Number of heads immature.	Number of heads not cut.	Ratio.	Date of harvesting.
ALL HEAD (Burpee's).								
Checked	12.0	2.8	**8.3**	1	0	0	**1.14**	August 18.
Not checked	11.6	3.3	**7.3**	0	0	0	**1.00**	August 18.
FLAT DUTCH.								
Checked	15.2	8.9	**10.7**	3	0	0	**1.09**	August 19.
Not checked	13.2	5.6	**9.8**	1	0	0	**1.00**	August 19.
SAFE CROP (Burpee's).								
Checked	10.0	5.5	**7.4**	0	0	1	**1.00**	August 18.
Not checked	10.2	6.4	**8.6**	0	0	1	**1.16**	August 18.
RED.								
Checked	13.2	5.3	**8.0**	2	0	1	**1.13**	September 12.
Not checked	11.3	1.3	**7.1**	1	2	0	**1.00**	September 12.

In most cases plants headed back at the last transplanting in the house were superior to those not thus checked. They were uniformly earlier, and were as a rule slightly larger. It is probable that the time elapsing between the check and the transfer to the field allowed the plants to recuperate and make a sturdy growth; while plants not treated were necessarily more or less drawn and not in as good condition for the final transfer.

Conclusion: Cabbage plants likely to become drawn and crowded before planting out, appear to be benefited by severe pruning of the foliage.

II—NOTES OF CAULIFLOWERS.

The cauliflower is a vegetable highly prized by many, but is too seldom met in the home gardens of our State. Possessing many of the good qualities of the cabbage it is, to a certain extent lacking in the peculiar rank flavor which renders the former disagreeable to many people. The delicate qualities of the cauliflower are, however, frequently disguised or lost through failure of the housewife to familiarize herself with the best methods of serving. For this reason we have given below some notes concerning the cooking of cauliflowers, condensed from material kindly furnished by Miss Anna Barrows, School of Domestic Science, Boston.

1. *Directions for Serving the Cauliflower:* A cabbage or cauliflower, unless taken directly from the garden is much improved if so placed that it can absorb water through its stalk for twelve to twenty-four hours before cooking. Soak a cauliflower, head down, in cold salted water for an hour before cooking to draw out any insects that may be concealed. A small cauliflower may be cooked whole and should be placed in the kettle with the flowerets up as the stalk needs the most thorough cooking; a large head should be divided into six or eight pieces.

Cook in a kettle of rapidly boiling salted water, to which may be added one-fourth of a level teaspoonful of soda. (The soda aids in softening the woody fibre.) The kettle should be skimmed occasionally while the vegetable is cooking, or, to save trouble, some prefer tying the cauliflower in a thin cloth. An agate or porcelain lined kettle is preferable to iron, which is likely to discolor the cauliflower.

The odor is less noticeable if the kettle is left uncovered. The water may also be changed to dispel the odor. A cauliflower should be tender after twenty to thirty minutes of rapid boiling. If overcooked it appears soggy and water-logged.

A good cauliflower, well cooked, requires little additional flavor beside salt and good butter. Some, however, prefer the addition of grated cheese. The cauliflower may also be served as a garnish for meats, in sauces, soups and is excellent cold as a salad. Many prefer it with a thick cream sauce.

"Cold boiled cauliflower is very good fried plain in butter, or breaded and fried, or mashed and fried like oyster plant, with the addition of an egg and a palatable seasoning of salt and pepper."

The last paragraph is from Miss Carson's Practical American Cookery. Many other hints may be obtained from this and other leading guides to cookery.

2. *Culture*: In a general way the culture is the same as for cabbages. Early varieties should be started in the house or hot-bed as soon as the first of April. Handle as needed, and set in the open field as early as possible. The best soil is a rich, moist loam, but it should be well drained. Like the cabbage, the cauliflower is a gross feeder and demands intense culture. If growth is stopped from any cause, the heads are likely to "button" or form small sections interspersed with leaves, worthless for market purposes. Frequent cultivation is necessary, and it is probable that in case of very dry weather about the time of heading, irrigation would be a profitable means of securing a crop for home use at least. When the heads are about three inches across, the outer leaves should be brought together and held in place by means of a piece of twine or raffia, that the heads may be well bleached.

3. *Influence of Early Treatment*: The relative influence of pot and of box culture of young plants was considered with reference to the number of heads produced: Seed was sown April 3d; the young plants were transferred to two and one-half inch pots April 24th; to four inch pots May 10th, and to the field May 29th. A duplicate lot was handled in boxes at the same dates. At the last handling in the house, May 10th, the leaf surface was reduced about one-half. A tabular view of the results is given below:

TABLE IV,

CAULIFLOWERS IN POTS AND BOXES.

VARIETY.	Number heads cut July 26.	Number heads cut August 3.	Number heads cut August 15.	Number heads cut August 28.	Total number heads.	Number of plants.	Per cent of plants forming heads.
DWARF FRENCH, Half Early Dwarf French.							
Pots	1	4	1	0	6	13	**46.2**
Boxes	0	4	1	0	5	21	**23.8**
GILT EDGE (Thorburn).							
Pots	4	9	2	1	16	17	**94.5**
Boxes	2	7	2	1	12	16	**75.0**
PARIS, Extra Early Paris.							
Pots	2	1	0	0	3	17	**17.6**
Boxes	0	0	2	1	3	17	**17.6**
LONDON, Large Early London.							
Pots	0	0	1	10	11	20	**55.0**
Boxes	0	0	3	10	13	21	**61.9**

In two instances there was a difference of twenty per cent in favor of the plants grown in pots. One variety gave the same number of heads in each case but the plants from pots were two to three weeks earlier than the others. The fourth variety gave a slight difference, about seven per cent, in favor of the box treatment. Doubtless any benefit that might arise from handling plants in pots would lie in the fact that the plants are kept at a more uniform rate of growth.

Conclusion: Indications point to an increased percentage of marketable heads as a result of handling cauliflower plants in pots during early stages of growth.

4. *Effects of Trimming:* The value of reducing the amount of foliage at the time of removal to the field with reference to the heading of cauliflower, received some attention. The seed was sown April 3, the young plants were transferred to boxes April 24 and again May 10. All were removed to the field May 29, when the foliage of one lot was reduced by one-half while a duplicate lot was left without trimming.

The table shows the relative earliness and the per cent of heads formed.

TABLE V.

EFFECT OF TRIMMING CAULIFLOWERS.

VARIETY.	Number heads cut July 26.	Number heads cut August 3.	Number heads cut August 15.	Number heads cut August 28.	Number heads cut September 15.	Total number heads.	Number of plants.	Per cent of plants forming heads.
ALABASTER.								
Trimmed	3	4	1	2	-	10	12	**83.3**
Not trimmed	4	5	2	-	-	11	12	**91.7**
ERFURT (Large Early Dwarf).								
Trimmed	-	5	4	1	-	10	13	**76.9**
Not trimmed	-	7	3	1	-	11	13	**84.6**
ERFURT (Ordinary).								
Trimmed	-	4	7	6	-	17	19	**89.5**
Not trimmed	-	7	3	7	1	18	19	**94.7**
PRIZE EARLIEST.								
Trimmed	-	4	2	4	-	10	14	**71.4**
Not trimmed	-	-	5	4	-	9	13	**69.2**
STADTHOLDER.								
Trimmed	-	-	-	3	2	5	10	**50.0**
Not trimmed	-	-	-	3	-	3	9	**33.3**

As a rule, the per cent of heads formed was greater from plants not trimmed. There was practically no difference in the earliness of the two lots, nor was there a marked difference in the size of the heads.

Conclusion : Results obtained will not warrant us in commending the practice of trimming cauliflower plants severely at time of setting in the field.

5. *Varieties:* Nearly all of the more important varieties of cauliflower were grown in our gardens the past season for purposes of comparison. We found, as was expected, a marked variation in different strains of the same type. The accompanying table will give a comprehensive view of the comparative merits of the different strains and varieties as regards earliness, percentage of heads formed, and average weight of heads. The latter quality is necessarily only relative; for a few days time, even after the head is ready for market makes a decided difference in weight.

TABLE VI.

VARIETIES OF CAULIFLOWER.

VARIETY.	Number heads cut July 26.	Number cut August 3.	Number cut August 15.	Number heads August 28.	Number heads September 15.	Number heads after October 1st.	Total number heads cut.	Number of plants.	Per cent of plants forming heads.	Average weight per head—lbs.
Autumn Giant	-	-	-	1	2	2	5	14	**35.7**	9.7
Best Early (Burpee's)	8	4	2	-	-	-	14	14	**100.0**	1.9
Dwarf Erfurt, extra early	3	3	5	1	-	-	12	12	**100.0**	2.8
Dwarf Erfurt, ordinary	-	7	3	7	1	-	18	19	**94.7**	3.7
Early Alabaster	4	5	2	-	-	-	11	12	**91.7**	1.3
Early Dwarf Danish	7	12	1	-	-	-	20	20	**100.0**	2.7
Early Paris	-	2	5	3	-	-	10	13	**76.9**	2.7
Early Asiatic	-	2	5	3	1	-	11	11	**100.0**	3.3
Early London	-	-	3	10	-	-	13	21	**61.9**	3.9
Extra Early Paris	-	-	2	1	-	-	3	17	**17.6**	0.9
Giant Purple, early	-	-	-	1	2	2	5	15	**33.3**	4.8
Giant Purple, late	-	-	-	1	2	1	4	16	**25.0**	7.9
Half Early Dwarf French	-	4	1	-	-	-	5	21	**23.8**	1.5
Imperial	1	6	2	1	-	-	10	11	**90.9**	2.6
Italian Taranto	-	-	-	1	3	-	4	22	**18.2**	6.9
Kronk's Perfection	7	5	3	1	-	-	16	16	**100.0**	2.2
Landrettis First	-	16	3	1	-	-	20	20	**100.0**	3.3
Large Late Dutch	-	-	-	2	1	-	3	24	**12.5**	6.0
Large Algiers	-	-	4	3	-	-	7	14	**50.0**	2.0
Large Early Dwarf Erfurt	-	7	3	1	-	-	11	13	**84.6**	2.0
Lenormand's Short Stem	1	-	4	1	-	-	6	18	**33.3**	1.1
Livingston's Earliest	8	4	1	1	-	-	14	18	**77.8**	3.2
Long Island Beauty	-	8	7	-	-	-	15	15	**100.0**	2.3
Nonpareil	-	-	4	5	1	-	10	15	**66.7**	3.0
Prize Earliest	-	-	5	4	-	-	9	13	**69.2**	3.2
Stadtholder	-	-	-	3	-	-	3	9	**33.3**	5.0
Thorburn Early Snowball	2	4	2	3	-	-	11	14	**78.6**	2.2
Thorburn Gilt Edge	2	7	2	1	-	-	12	16	**75.0**	0.6
Vaughan's Danish Snowball	2	7	2	1	-	-	12	12	**100.0**	
Walcheren	-	-	-	2	-	-	2	10	**20.0**	2.6

As will be seen, nearly all of the earliest varieties produced a high percentage of marketable heads, while the later sorts were anything but satisfactory. Of the whole number of varieties grown sixteen produced more than seventy-five per cent of marketable heads, while with eight varieties, every plant produced a good head. The earliest varieties were Burpee's Best Early, Dwarf Danish, Kronk's Perfection, and Livingston's Earliest. These were closely followed by Alabaster, Landreth's First, Long Island Beauty and several strains of Snowball.

Most of the late varieties were checked by the dry weather and showed a tendency to "button," or go to seed, hence are not considered here.

The following field notes concerning the more important varieties were made

Alabaster: (Johnson & Stokes).—Said to be a sport from *Dwarf Erfurt* (see below). A small early variety. An erect grower and may be planted closely.

Autumn Giant: (Thorburn).—A very large late variety of excellent quality; should not be started so early as most other sorts.

Best Early: (*Burpee's Best Early*, Burpee).—Small, but one of the earliest and surest heading varieties.

Dwarf Erfurt: (Thorburn).—Takes its name from the city of Erfurt, Germany, where cauliflowers are extensively grown One of the most popular early varieties Several strains were grown this year, of which the best seemed to be Thorburn's Extra Early.

Early Danish: (Farquhar).—Of the Erfurt type; forming a medium sized head, very firm and good. One of the best.

Early Paris (Thorburn, Farquhar).—Moderately vigorous, with long stem and of spreading habit. Leaves covered with heavy bluish white bloom giving the variety a characteristic light shade. Heads of fair size but lacking in solidity.

Giant Purple. (Childs).—A large, late variety, very attractive when growing, and of excellent flavor, but when served its color is objectionable.

Imperial. (Landreth).—A medium sized pure white variety. Of spreading habit and heads not very firm.

Kronk's Perfection. (Farquhar).—A very fine strain of the Erfurt type. Of medium size, early, uniform, and in our plantation was among the best.

Landreth First. (Landreth).—Of vigorous, erect habit, but having a short stem. Heads of medium size, very solid, white, and rather remarkable for uniformity. One of the best.

Livingston's Earliest. (Livingston).—One of the earliest, small but uniform in date of maturity, a valuable consideration in a market variety.

Long Island Beauty. (Gregory).—A valuable second early sort. Only two cuttings were necessary and every plant produced a marketable head.

Prize Earliest. (Maule).—Three weeks later than some of the other varieties. Not satisfactory this season

Snowball. (*Early Snowball*, Thorburn).—A moderately vigorous variety forming small but very solid heads. From this type many valuable strains have been derived. One of the most valuable of these is the next mentioned.

Thorburn Gilt Edge. (Thorburn) —This variety is not quite so vigorous as the parent, the leaves are slightly smaller and very dense, while the stem is shorter. Heads small but handsome, and usually one of the most reliable.

Vaughan's Danish Snowball. (Vaughan).—Differs little in habit from Snowball described above. Very early and apparently a sure header.

London, Italian Taranto, Late Dutch, Algiers, Nonpariel, Stadtholder and some others while producing very good individual heads, were not reliable, the present season, and notes concerning these are withheld until further trial.

SUMMARY.

1. The general treatment of the cauliflower is similar to that required by cabbages. Thorough and frequent cultivation are essential.

2. Handling plants in pots before setting in the field increased the percentage of marketable heads.

3. Trimming plants at time of setting is of doubtful value.

4. Early varieties are, as a rule, more certain to produce a satisfactory crop than are the late sorts.

5. The earliest varieties grown the past season were: Burpee's Best Early, Dwarf Danish, Kronk's Perfection and Livingston's Earliest; closely followed by Alabaster, Landreth's First, Long Island Beauty and several strains of Snowball. All of these produced a high percentage of marketable heads.

III—NOTES OF TOMATOES.

As heretofore, special attention was given to methods of culture rather than to a multiplicity of varieties. Many of the experiments undertaken last season were repeated, for as before stated, positive conclusions can not be drawn from a single season's work.

1. *Effects of Early Setting*: A dozen plants of each of three varieties were used in the test. All were given similar treatment in the house. The first lot was removed to the field May 23d The other a week later Owing to a heavy frost on the night of May 27th the early set plants were severely checked; while the weather for some days was cold and raw, but very dry. In spite of this check the first lot recuperated and by the first of October there was practically no difference in the two lots.

Table VII gives an exact statement of the results:

TABLE VII.

EFFECT OF EARLY SETTING.

VARIETY.	Date of first ripe fruit.	Average number fruits per plant.	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Number fruits per plant before October 1st.	Number decayed fruits per plant before October 1st.	Total number decayed fruit per plant.
BUCKEYE STATE.							
First setting....	Aug. 9..	11.0	6.4	9.3	**6.4**	1.3	**5.6**
Second setting	Aug. 10..	8.6	5.3	10.0	**5.7**	2.0	**4.5**
BURPEE'S CLIMAX.							
First setting..........	Aug. 4..	27.3	8.4	4.9	**19.8**	1.4	7.3
Second setting..................	Aug. 2..	33.6	10.4	4.9	**20.8**	1.2	10.6
GREAT B. B........							
First setting	Aug. 27..	23.9	8.6	5.8	**13.9**	1.3	9.8
Second setting...	July 27..	29.5	11.0	6.0	**13.4**	1.9	15.5

There was very little difference in the time of ripening of the first fruits; and on the first of October, a date as late as can usually be relied on for tomatoes, there was practically no difference in the number of fruits produced by the two lots. The slight variation found was in favor of the early set plants.

As will be see by the last two columns in the table, the number of decayed fruits was very greatly increased late in the season, amounting in some cases to 75 per cent. of the fruit gathered.

Conclusion: While not so marked as in previous trials, indications still point to the value of early setting of tomato plants.

2. *Value of Pot-Culture*: The importance of careful handling of tomato plants has been emphasized in previous reports, and a limited amount of work has been done in this direction at this station.

During the past season a test of the relative value of pot-culture during the early stages of growth was conducted on lines similar to those detailed on page 102 for cabbage plants. A dozen plants of each of four varieties were transferred from the seed-flats to thumb-pots on April 27th, to three-inch pots May 9th, to four-inch pots May 20th, and to the open ground June 1st A duplicate lot was handled in flats at the same time. The results are shown in table VIII.

TABLE VIII.

VALUE OF POT CULTURE OF TOMATOES.

VARIETY.	Average number fruit per plant.	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Average number fruits per plant before October 1st.	Ratio (by number of fruit.)	Bushels per acre, before October 1st.
IGNOTUM.						
Pots	19.0	8.9	7.5	**10.5**	**1.28**	**139.4**
Boxes	12.3	5.9	7.7	**8.2**	**1.00**	**110.3**
ITHACA.						
Pots	23.5	6.7	4.6	**15.8**	**1.42**	**127.8**
Boxes	15.5	4.7	4.0	**11.1**	**1.00**	**98.7**
OPTIMUS.						
Pots	32.0	7.9	3.9	**14.2**	**1.21**	**112.1**
Boxes	16.5	4.3	4.2	**11.7**	**1.00**	**83. 0**
STONE.						
Pots	14.3	5.5	6.2	**7.4**	**1.39**	**72.6**
Boxes	9.1	5.1	8.2	**5.3**	**1.00**	**81.3**

In every instance there was a marked increase in the number of fruits from plants handled in pots, and in the total weight of fruit produced. It will be observed, however, that the individual fruits averaged larger on the plants from boxes. This fact is no doubt due to the smaller numbers borne, as before mentioned.

In the last column is given the number of bushels per acre before October 1st, on the basis of the weight of fruit picked at that time, and considering the plants placed five feet apart each way in the field. With one variety the difference is slightly (about 9 bushels per acre) in favor of the box culture. This difference being due to the marked increase in size. But the first three varieties show a difference of more than 29 bushels each, in favor of the pot-grown plants. This difference, at 75 cents per bushel (none of our fruit was sold at less than 60 cents per bushel, and early in the season we received $1.75 at wholesale), would amount to $21.83 per acre, —a sum that would far more than pay for the cost of pots and the slightly increased cost of handling in the house.

Conclusion: There appears to be a marked increase in the productiveness of plants handled in pots previous to setting in the field.

3. *Individual Variation*: The danger from drawing too free conclusions from a single season's work was suggested last year, when it was found that, "In no case were the results from duplicate tests uniform."* A similar test of the variation of duplicate lots of any given variety was conducted the past season. The results bear out our former conclusion to such an extent that results of certain methods of culture undertaken are withheld for further verification.

Table IX shows the comparative results obtained with duplicate lots of each of three varieties, all of which were given the same treatment in house and field.

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*Report Maine Experiment Station, 1892, page 64.

TABLE IX.

INDIVIDUAL VARIATION.

VARIETY.	Average number fruits per plant.	Average weight of fruit per plant—lbs.	Average weight of individual fruits—ounces.	Average number decayed fruits per plant.	Date of first ripe fruit.
GOLDEN QUEEN	**13.9**	4.5	**5.2**	4.9	August 2.
	19.0	6.6	**5.5**	5.3	August 9.
ROSE PEACH	**16.6**	3.2	**3.1**	2.3	August 7.
	13.1	2.4	**3.0**	2.7	August 7.
ROYAL RED	**14.4**	5.6	**6.2**	6.3	August 7.
	15.0	5.8	**6.1**	6.7	August 4.

The weight of individual fruits was practically uniform, but the variation in number of fruits and in the consequent weight of the product was very marked. The date of ripening was also variable.

Conclusion: The individual variation of plants of any given sort is often such as to obscure any effects of different methods of culture. Results previously obtained are confirmed.

4. *Crossing*: Some of our work in developing a tomato which shall be of sufficient earliness to be profitable as a market crop in those sections where the seasons are short, was detailed in our last annual report.* Selections and further crosses were made the present season with interesting and promising results.

The *Lorillard-Peach* cross showed a less marked increase over the pure Lorillard, in number of fruits than was the case in the first generation,—a fact which illustrates the principle frequently laid down that crossing within the limits of the species tends to promote fruitfulness. In the second generation the influence of the male parent on the character of the fruit was shown by several individuals which assumed the peculiar rough skin, and to a certain extent the form of Peach.

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*Report Maine Experiment Station, 1892, p. 65.

The *Ignotum-Peach* cross showed a similar falling off in th second generation, as shown below.

IGNOTUM × PEACH.	Average number fruits per plant (both ripe and green.)	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Average number
First generation	**191**	30.3	2.5	**5**
Second generation	**107**	17.4	2.6	**3**

As will be seen there is a falling off of nearly forty-four per cen in the total number of fruits borne. It is however quite possibl that the conditions under which the parents were grown in the tw generations may account for some of this variation.

The original parent was grown in the house and was speciall cared for. The plants from which the "second generation" in thi trial came, were given ordinary field culture, though the groun was rich and the plants were well cared for

We know that conditions of growth during a single generation exert a marked effect on the vitality of seeds. This influence extending further in the life history of the plant, may determin to a certain extent the character of any strain. In this way i would seem possible that by forcing plants to early development i the house and by limiting the amount of fruit borne for a few generations, a strain of unusual vigor may be produced. This question is receiving attention in our houses at the present time.

The result obtained from crossing the *Lorillard-Currant* hybri described in our last report,* with the female parent—Lorillard— promises valuable results. Naturally the number of fruits i reduced, but the size is fully doubled, while the quality is muc improved.

5. *Varieties*: The tomatoes were started in the forcing hous March 27th. All varieties were given the same treatment while i the house and were transferred to the open field June 1st. Th first ripe fruits were found July 25th, on Golden Ball and Lon Keeper. Two days later one or more fruits were gathered fron Aristocrat, Great B. B., Ithaca and Maule's Earliest.

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*Report Maine Experiment Station, 1892, page 68.

On October 1st, when the season was practically ended, the following varieties were found in the order named, to have been the most productive: Golden Ball, Improved Peach, Maule's Earliest, Burpee's Climax, Lorillard, Ithaca and Belmont. Optimus, which was the most productive sort grown last year stood *ninth* (or dropping the first two varieties which are of value for amateur culture only, *seventh*) in the list the present season.

The large late varieties, such as Belmont, Buckeye State and Stone. decayed very badly late in the season. The same is true to a certain extent of Ignotum, Matchless and Optimus.

Maule's Earliest and Burpee's Climax were both much smoother than is usual with very early sorts, and are promising.

Ithaca and Long Keeper deserve the credit given in previous reports.

Lemon Blush failed to blush and was consequently inferior to Golden Queen.

Buckeye State, Royal Red and Stone, while of merit as individual fruits, are all too late for our short seasons. Ponderosa will be discarded for similar reasons.

Terra Cotta was of very unsatisfactory quality, and is not a firmly fixed variety.

Great B. B., in spite of its name is a fairly good variety. It decayed badly late in the season.

SUMMARY.

1 The conclusions of former years as to the value of setting tomato plants as early in the spring as possible are confirmed.

2. Plants handled in pots previous to setting in the field are more vigorous and productive than those not so handled,—a fact which may be of great importance to the commercial grower.

3. Individual variation is often such as to render the work of any one season unreliable.

4. The productiveness of any given variety may be largely increased by crossing with some of the smaller less valuable sorts. But this increased productiveness may be partially or wholly lost in a few years even if good culture is given. The variety will quickly "run out."

5. It seems possible that seeds from plants grown under high culture in the house may give better results than those from plants not so treated.

6. By combining the Lorillard-Currant hybrid, with the Lor lard, the size has been more than doubled, and the quality is mu improved.

7. Of the newer varieties, Burpee's Climax, Maule's Earlie and "B. B." were among the most promising. Buckeye Stat Ponderosa, Royal Red and Stone are too late for our climat Lemon Blush lacked its distinguishing characteristic, and Ter Cotta was of inferior quality.

IV—NOTES OF EGG PLANTS.

Our work with egg plants during the past season has been pri cipally confined to methods of culture, including time of settin deep and surface cultivation; the value of frequent cultivation, th effect of root pruning. In all cases seed was sown March 17. Tl young plants were pricked out into seed flats April 28; transferre to 4-inch pots May 22, and with the exception of one lot, to tl open field June 10.

1. *Value of Early Setting*: The egg plant, being of tropic origin, is very sensitive to sudden changes of temperature. Tl question has therefore arisen: Will not plants give more satisfa tory results if allowed to remain in the house till the season is we advanced, provided they are not checked or crowded?

The writer has usually advocated setting plants about the 10th the 15th of June, but as bearing upon this point two lots of each three varieties were given similar treatment during the season, sa that one lot was set in the field June 10, and the other June 21, tl season being unusually late. The comparative results are shown table X.

TABLE X.

EARLY *vs.* LATE SETTING OF EGG PLANTS.

VARIETY.	Number of plants.	Number of plants bearing marketable fruits.	Number of marketable fruit.	Per cent of plants bearing marketable fruit.
EARLY DWARF PURPLE.				
Early set	18	18	**40**	**100.0**
Late set	15	13	**15**	**86.7**
EARLY LONG PURPLE.				
Early set	17	12	**30**	**70.6**
Late set	16	10	**17**	**62.5**
BLACK PEKIN.				
Early set	18	18	**21**	**100.0**
Late set	17	11	**12**	**64.7**

It will be observed that in every instance the lot set June 10, produced a larger percentage of plants bearing marketable fruits than did the lot set later. This difference in one case—Black Pekin—amounted to more than 35 per cent. The average number of marketable fruits on the bearing plants was also much larger from those set early. Dwarf Purple produced nearly twice as many fruits from the first lot as from the others.

This difference is due to two causes. Fruits seem to set more freely in the warm days of July and August—hence the desirability of having the plants in full vigorous growth at that time; while the fruits formed later are almost certain to be injured by frost before reaching edible maturity.

Conclusion: The percentage of plants bearing marketable fruits, also the productiveness of individual plants, is considerably less from plants set late in June than from those set earlier.

2. *Deep vs. Shallow Cultivation*: We have always recommended constant cultivation as one of the first requisites to success with egg plants. There is a question, however, whether it is advisable to disturb the roots to so great a depth as is commonly done with the ordinary farm cultivator. As bearing upon this point a

number of plants of each of three varieties were given ordinary deep cultivation, while a duplicate lot, planted by the side of the first was given very shallow cultivation. The first lot was cultivated about once in ten days with a Planet Jr. horse hoe; the second was hoed by hand at the same time.

The results obtained are shown in table XI.

TABLE XI.

DEEP *vs.* SHALLOW CULTIVATION OF EGG PLANTS.

VARIETY.	Number of plants.	Number of plants bearing marketable fruit.	Number marketable fruits.	Per cent of plants bearing marketable fruit.
ROUND WHITE.				
Deep	11	10	17	90.9
Shallow	15	10	14	66.7
CREOLE.				
Deep	13	7	9	53.8
Shallow	12	2	2	16.7
NEW YORK IMPROVED.				
Deep	14	5	5	35.7
Shallow	15	6	7	46.7

As will be observed Creole and Round White were much more productive when deep cultivation was practiced. New York Improved was very unproductive in both cases, but the plants given surface cultivation were slightly the more productive. The season was very dry and it is probable the chief advantage of the deep cultivation was in driving the feeding roots downward, the lose earth above forming a mulch.

Conclusion: Better effects appear to result from the deep cultivation of egg plants with the horse hoe than from shallow hand work.

3. *Is Frequent Cultivation Essential?* The writer has usually advised cultivating egg plants as often as once a week. And is often met by the farmer with the objection of "too much bother." An attempt was made the present season to determine if frequent

cultivation really is essential to success. Some plants were given the ordinary treatment of our garden, while a duplicate lot was given only sufficient attention to keep down the weeds. Unfortunately the varieties used—New York Improved and Round Purple—proved so unproductive that we are not justified in drawing final conclusions. In this instance, however, the plants given infrequent cultivation produced fully as many fruits as those under conditions usually regarded as more favorable. If it be proved that the egg plant may be grown with less care than commonly supposed, the fact, though of no importance to the gardener, may serve to remove some objections to the more common use of this vegetable.

4. *Effects of Root Pruning*: To ascertain whether a sudden check in the growth of the plants would result in increasing the number of fruits set, several of the main roots of a number of plants were severed August 19, after a small number of fruits had formed. Results were contradictory. Some varieties showed considerable increase in the number of fruits set, as compared with duplicate plants not pruned; others were apparently injured by the operation. The advantage of the operation from a practical point of view is questionable.

SUMMARY.

1. The percentage of plants bearing marketable fruits, and the productiveness of individual plants, are increased by early setting in the field.
2. Better results are obtained from deep cultivation with the horse hoe than from shallow hand work.
3. Early dwarf varieties may be successfully grown with the ordinary care given tomato plants.
4. The advantage of root pruning egg plants is questionable.

V—NOTES OF POTATOES.

The principal work heretofore undertaken with potatoes has been in the line of a study of the influence of climate in causing variation of the plant—an experiment still in progress. During the past season a few experiments with different methods of culture were taken up incidentally.

1. *A comparison of the Trench System with Ordinary Culture*: A few years ago considerable interest was aroused by the accounts of wonderful yields of potatoes obtained by a system of culture

known as the *Rural New Yorker Trench System.* The syste derives its name from the fact that it was first used at the tr grounds of the *Rural New Yorker*, and was advocated by the edit of that paper, Mr. E. S. Carman.

The system consists essentially in planting the tubers in trenche five to seven inches deep and twelve to fifteen inches wide, t bottoms of which are well pulverized; covering to a depth of abo two inches; then applying any desired amount of fertilizer in t trench; after which the trenches are filled so that after settling t surface shall be level.

Now it has been the practice of the writer for several years plant in furrows, applying fertilizers broadcast on the surface of t ground, for there is little doubt that the old custom of "hillin potatoes is worse than useless, it is positively injurious to the cr on dry soils It has seemed doubtful, in view of the fact that t roots of the potato extend in all directions, filling the whole spa between the rows, whether placing the fertilizer in a trench onl could be as rational, or in practice as satisfactory, as the oth method.

In the paper referred to and also in a book recently publishe the statement is made that, "In every trial made the land laid o in trenches whether with or without fertilizer or manure has large out-yielded that planted according to the old method of furrows hills."*

In an issue of the *Rural New Yorker* of recent date is a detaile account of a comparison of the two methods as conducted on t grounds of the originator of the "Trench system." From this tri the following conclusions were drawn:

"There is a difference in the total yield per acre of only one-ha bushel (.49) in favor of the trenches, but of the *marketable* potato there is a difference of over seventeen bushels per acre in favor the trenches.

"The yield of small potatoes (unmarketable) of the furrows 16.79 bushels per acre greater than that of the trenches."†

The work of this Station planned without the knowledge tha similar work was being undertaken elsewhere, is detailed below:

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* The New Potato Culture, page 35.

† Rural New Yorker, October 14, 1893, page 683.

On a piece of sandy loam, having a Southern aspect, alternate rows of the varieties named below were planted three and one-half feet apart—one being "trenched," the other planted in a furrow. The rows "trenched" were plowed about a foot wide and eight inches deep, after which the soil in the bottom of the furrow was loosened and pulverized, some earth being worked back into the furrow, the "seed" cut into two eyes was then planted one foot apart in the row. The pieces were covered to a depth of about two inches when a complete fertilizer at the rate of 1,000 pounds to the acre was scattered in the trenches, and the trenches were filled. The other rows were simply plowed, the seed pieces dropped and covered, when the same amount of fertilizer as before was scattered on the surface. As soon as the young shoots appeared above the surface, the smoothing harrow was used, and thorough culture was given until about the middle of July when the vines covered the ground sufficiently to keep the weeds down and serve as a mulch for themselves.

The comparative results are shown in the accompanying table:

TABLE XII.

TRENCH SYSTEM *vs.* ORDINARY CULTURE OF POTATOES.

VARIETY AND SYSTEM.	Weight of product—lbs.	Weight of marketable tubers—lbs.	Weight of small tubers—lbs.	Average number marketable tubers per hill.	Yield per acre of marketable tubers—bushels.	Yield per acre of small tubers—bushels.
EARLY ROSE.						
No 1. Furrow	58.87	51.03	7.84	**5.6**	**234.4**	**34.6**
Trench	61.48	53.24	8.24	**5.0**	**244.8**	**37.9**
No. 2. Furrow	80.00	71.00	9.00	**6.9**	**327.7**	**41.5**
Trench	79.23	68.72	10.51	**6.1**	**317.4**	**48.5**
CRANE'S JUNE.						
No. 1. Furrow	69.90	62.00	7.90	**6.0**	**286.2**	**36.3**
Trench	66.30	54.81	11.49	**5.2**	**253.1**	**52.9**
No. 2. Furrow	70.19	58.45	11.74	**5.9**	**269.6**	**54.1**
Trench	71.57	61.04	10.53	**5.8**	**282.1**	**48.5**
HEBRON.						
Furrow	64.15	59.12	5.03	**5.4**	**271.7**	**23.2**
Trench	74.07	65.16	8.91	**5.4**	**300.8**	**41.1**

In every instance duplicate lots produced contradictory result The first lot of Early Rose gave a greater yield from the trench–the difference being nearly ten bushels of marketable tubers p acre. The second lot reverses these figures so far as the marke able tubers are concerned, but the increased numbers of sma tubers makes the total yield practically the same with the tw methods of treatment. The first lot of Crane's June gave a diffe ence of thirty-three bushels of marketable tubers per acre in fav of the furrow; while in the second lot the trench produced at th rate of twelve bushels per acre more than the other.

In each instance above mentioned, the number of marketab tubers per hill was slightly smaller in the trenches, and the weig of individual tubers was somewhat greater; on the other han with one exception the small tubers from the trenches excelled i weight and number those from the furrows.

Hebron from the trench was superior to the same variety fro the furrow. The number of tubers per hill was the same, but th individual tubers from the trench were so much superior as to b equivalent to an excess of twenty-nine bushels per acre over th other.

It will be seen that these facts are in a measure opposed to co clusions concerning the system which have heretofore been publishe We would not, however, condemn the method without further tria It is but just to say, however. that certain parties quoted as obtai ing specially marked results from the use of the "trench system have discarded the method in their general practice.

Conclusion: It is questionable whether the results obtained wi justify the extra labor involved in practicing the trench system o potato culture. In our trials the past season duplicate lots in ever instance produced contradictory results.

VI—Notes of Spraying Experiments.

Spraying with some solution of copper for protection from th attack of the apple scab is coming to be looked upon as a necessit by many of the more progressive orchardists. During the pas three seasons the writer has been engaged in solving some of th problems incident to this work. The results, so far as obtaine have been detailed in the annual reports of the experiment station.

The principal work of the present season was a comparison o the effectiveness of different mixtures. The failure of certain trees set apart for that purpose, prevented reaching more definite conclusions regarding the best time for spraying

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* Report Maine Experiment Station, 1891, page 112; and 1892, page 92.

The materials used in the work here mentioned, were as follows:

1st.—*Modified eau celeste.*—2 lbs. copper sulphate, 1 1-2 lbs carbonate of soda, 1 1-2 pts ammonia and thirty-five gallons of water.

2nd.—*Bordeaux Mixture.*—6 lbs. copper sulphate (Blue Stone). 4 lbs. fresh lime dissolved separately, then mixed and diluted to 40 gallons.

3d.—*Bordeaux Mixture and Paris Green.*—Same as No 2 with addition of Paris Green in the proportion of 1 lb to 150 gallons

4th.—*Paris Green*—1 lb Paris green in 250 gallons water.

The season was very dry and the trees were much freer from scab than in previous years. That there was marked benefit from the treatment is, however, shown in the accompanying photographs of fruit from contiguous trees and also in the table.

No. 1—NOT SPRAYED.

Free, 130. Badly Scabbed, 17. Slightly Scabbed, 392.

No. 2—SPRAYED

Free, 474. Badly Scabbed, 3. Slightly Scabbed, 114.

TABLE XVI.

RESULTS OF SPRAYING TO PREVENT APPLE SCAB.

TREATMENT	Number fruits examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Per cent free.
EAU CELESTE	651	480	156	15	73.7
	557	360	189	8	64.6
	460	369	73	18	80.2
Average per tree	**556**	**403**	**139**	**14**	**72.5**
BORDEAUX MIXTURE	501	399	91	11	79.6
	591	474	114	3	80.2
Average per tree	**546**	**436**	**102**	**7**	**79.9**
BORDEAUX MIXTURE AND PARIS GREEN	811	677	128	6	83.5
	639	509	126	4	79.7
	615	524	87	4	85.2
Average per tree	**733**	**570**	**114**	**5**	**82.8**
CHECKS NOT SPRAYED	566	214	337	15	37.8
	550	291	248	11	52.9
	539	130	392	17	24.1
Average per tree	**552**	**212**	**326**	**14**	**38.3**

Much of the fruit classed as "slightly scabbed" would grade as No. 1 fruit, but as is well known, the fungus grows rapidly after the fruits are packed; hence our arbitrary line between fruit *absolutely free* from scab and that slightly affected is rigidly adhered to.

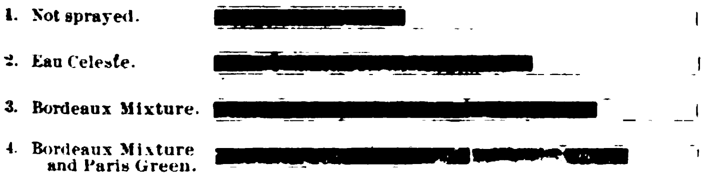
As shown by the table, the best results were obtained from the use of a combination of Bordeaux mixture and Paris green. This fact would indicate a possible fungicidal value for Paris green. That this value is slight, however, was shown by some trees sprayed with Paris green only. Our experiments have not been sufficiently extended to warrant definite conclusions on this point. The Paris green has, however, an important use in reducing the proportion of wormy fruits.

Eau Celeste, while less effectual than Bordeaux mixture in preventing scab, was found to injure the foliage unless used with caution. The fruit also, was made somewhat rusty—the epidermis apparently being injured by the ammonia.

The relative value of the different materials used may best be summarized as follows:

Checks, not sprayed..	38.3	per cent free from scab.
Modified *Eau Celeste*	72.8	“ “ “ “
Bordeaux mixture..	79 9	“ “ “ “
Bordeaux mixture and Paris green,	82 8	“ “ “ “

These differences are graphically portrayed in the accompanying diagram, in which the shaded portion represents the per cent of fruit free from scab.



The concensus of opinion among experimenters at the present time places Bordeaux mixture at the head of the list of fungicides. A general summary of results obtained by the writer during the past three seasons is as follows, the figures representing the per cent. of fruit free from scab:

SPRAYING EXPERIMENTS, 1891-93.

	Checks not sprayed.	Ammonio-copper carbonate.	Modified eau celeste,	Bordeaux mixture.
1891	4.1	47.8	57.8	
1892	.98	6.1	30.1	
1893	38.3	-	72.8	79.9

A BRIEF RETROSPECT.

For the benefit of those who have not received previous reports, it may be well to give a brief resumé of the results obtained from three seasons' experiments.

We have seen that apple scab is caused by a parasitic fungus which attacks the leaves and young twigs as well as the fruit, and that the growth of the tree may be seriously checked. Spraying the trees with certain compounds of copper has been found an effective means of holding the disease in check,—the increase of salable fruit, as a result of spraying, often amounting to 50 per cent.

Indications point strongly to the value of spraying early in the season, before the blossoms open, and of repeating the application four or five times during the season.

The best results have been obtained from the use of Bordeaux mixture, prepared as follows: 6 pounds copper sulphate (Blue Stone); 4 pounds quick lime; 40 gallons water.

Dissolve the copper in a pail of hot water; slake the lime in another vessel; mix and dilute as above for use.

Farmers are advised to club together in the purchase of apparatus and chemicals, thus reducing expense.

Necessary chemicals may be obtained in large quantities of: Weeks & Potter Company, Boston; Eimer & Amend, 205 Third Avenue, New York; W. S. Powell & Company, Baltimore, Md. Most of the materials may be purchased in small amounts at the local drug store.

Force pumps and other apparatus for spraying may be obtained of any of the leading manufacturers, as: Field Force Pump Company, Lockport, N. Y.; Gould's Manufacturing Company, Seneca Falls, N. Y.; W. & B. Douglass, Middletown, Conn.; The Deming Company, Salem, O.

The most satisfactory nozzle we have used is the "McGowen," manufactured by John J. McGowen, Ithaca, N. Y. Our second choice is the "Climax," manufactured by the Nixon Nozzle and Machine Company, Dayton, O.

For spraying currant bushes, or for general garden use, the "Knapsack Sprayer" made by the Gould's Manufacturing Company, Seneca Falls, N. Y., has been found very satisfactory. Similar machines may be obtained from the other sources mentioned above.

VII—CATALOGUE OF MAINE FRUITS.

One of the most important lines of work receiving attention from this division is that of the systematic effort to improve the character of some of our native fruits, and to select from the ever increasing list of new varieties, those best suited for the different sections of the state. This work is still in its infancy and no results can yet be reported. It is thought best, however, to publish a catalogue of the fruits grown in the state at the present time with an indication of their approximate value in different sections.

The descriptions of fruits are mostly taken from the fruit list of the American Pomological Society, and the values accorded are given only after carefully considering the recommendations of leading fruit-growers in different parts of the State. Information concerning many varieties, especially in the northern sections is very meagre. It is hoped before a revision of the list is made,—as will necessarily follow in course of two or three years,—more valuable data may be available.

Of the newer apples named in the catalogue, Dudley's Winter, a seedling of Oldenburg originated by J. W. Dudley of Castle Hill, Aroostook county, is one of the most valuable "iron-clad" varieties. This variety is being disseminated by a New York firm as "North Star"—an unfortunate circumstance as there is another variety bearing that name by right of priority.

Hayford Sweet is another valuable iron-clad variety originating with C. Hayford, Maysville, Aroostook county. It is in itself a valuable fruit and succeeds where Talman Sweet fails.

Rolfe and Russell are also deserving of special mention. Mother, as a fruit for home use, is not as widely known as it should be; but it is not a profitable market variety.

Of the newer pears, Admiral Farragut, Eastern Belle, Fulton, Indian Queen and Nickerson are promising, hardy varieties. These are not of the highest quality but they are hardy and productive—important considerations especially for the northern and central portions of the state.

Flemish Beauty, formerly grown in many sections of the state, has been almost universally discarded because of the prevalence of pear scab (*Fusicladium pyrinum*). It is hoped that by the aid of the Bordeaux mixture we may yet retain this valuable variety.

Moore Arctic plum, (a native of Ashland, Aroostook county), because of its productiveness and extreme hardiness, is planted more extensively than any other variety in northern Maine. It is not, however, of the best quality. The Japanese varieties, Abundance and Burbank, are being tried to a limited extent in the southern portions of the state, but they can succeed only in the southern counties. McLaughlin, originated at Bangor more than forty years ago, is still one of our most valuable dessert plums. It is, however, rather tender for market purposes.

DeSoto, Forest Garden, Wolf, and some other varieties of the native "horse plum" or "pomegranate" (*Prunus Americana*), promise to be of some importance for the colder portions of the state.

Small fruits, though not largely grown for market, do well in all of the central and southern counties. The cool moist climate is specially adapted to the wants of the currant and gooseberry. Even as far north as Houlton, Aroostook county, the gooseberry is a profitable market crop; and if, as now seems probable, the English varieties will succeed in this climate, a very profitable industry is opened along this line.

The widely varying conditions existing in different parts of the state render a general statement as to the value of any given variety only approximately correct. Varieties which may be of merit in the southern portions of the state are not sufficiently hardy for the middle and northern counties. On the other hand, some sorts considered specially valuable in Aroostook county are unknown in York. In the accompanying catalogue we have assigned separate columns for the value of each variety in the northern and the southern parts of the state. The first column, marked "North," includes Aroostook, Piscataquis, and the northern parts of Somerset, Penobscot and Washington counties. The column marked "South," includes Oxford, Kennebec, Waldo, and all of the southern counties.

The value of any given variety is indicated thus: Two stars (* *) indicate a variety of special merit, one to be recommended for general culture. One star (*) shows that the variety is worthy of cultivation, though not superior. A dagger (†) indicates a new and promising variety, or an old variety not fully tested in this region. A dash (—) shows that the variety has been tried and found wanting.

The abbreviations used in describing the size*, form, color, etc., of the various classes of fruits are fully explained at the head of each list. Take for example the Alexander apple. We see that this is a large striped apple of roundish-conical form and moderately good quality, useful for cooking and market early in autumn.

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*A few varieties of apples usually described as large, are as grown in this state, of only medium size—e. g. Baldwin, Golden Sweet, Hubbardston, Porter.

APPLES.

ABBREVIATIONS USED.—*Size*,—l, large; m, medium; s, small. *Form*,—r c, roundish-conical; r ob, roundish-oblate; r, roundish. *Color*,—y r, yellow and red; r s, red striped; g y, greenish yellow; rus, russeted; y rus, yellow and russet. *Quality*,—g, good; v g, very good; b, best. *Use*,—F, family use; K M, kitchen and market; F M, family and market. *Season*,—S, summer; E A, early autumn; L A, late autumn; W, winter. *Origin*,—usual abbreviations for names of countries.

Number.	Names.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Alexander	l	r c	r s	g	K M	E A	Rus.	*	*
2	August	....	.....	.....	...	.....	.....	......	†	....
3	Autumn	....	.....	.....	...	.....	.....	......	†	....
4	Bailey Sweet	l	r c	r s	v g	F M	L A	Am.	..	*
5	Baldwin	l	r c	r g	v g	F M	W	Am.	—	**
6	Beauty of Kent	l	r c	r s	g	K M	L A	Eng.	....	*
7	Ben Davis	l	r c	y r	g	K M	W	Am.	—	**
8	Benoni	m	r ob	y r	v g	F M	S	Am.	....	*
9	Black Oxford	....	.....	.....	...	.....	.....	.....	—	—
10	Bloom	....	.....	.....	...	.....	.....	......	†	....
11	Blue Pearmain	l	r c	r	g	M	W	......	—	*
12	Bullock, *American Golden Russett*	s	r c	y rus	b	F M	W	Am.	...	*
13	Canada Baldwin	m	ob	r	v g	.....	W	Can.	....	*
14	Chenango (Strawberry), *Sherwood Favorite*	m	ob c	g r	v g	F M	E A	Am.	...	*
15	Cole Quince	l	r ob	g y	v g	F M	W	Am.	....	*
16	Colton	....	.....	.....	...	.....	.....	......	†	...
17	Cooper Market	m	r c	y r	g	M	W	Am.	...	*
18	Danvers Sweet, *Danvers Winter*	m	r ob	g y	v g	F M	W	Am.	....	*
19	Dudley Winter	m	r ob	y r	g	F M	W	Am.	**	*
20	Dyer, *Pomme Royal*	m	r	g y	v g	F	E A	F.	....	*
21	Early Harvest	m	r ob	g y	v g	F M	S	Am.	*	*
22	Early Scarlet	....	.....	.....	...	.....	.....	......	†	....
23	Early Strawberry *Red Juneating*	s	r	r s	v g	F	S	Am.	....	*
24	English Russett, *Poughkeepsie Russett*	m	r c	y rus	v g	F M	W	Eng.	....	—
25	Esopus Spitzenburg	l	ob	y r	b	F M	W	Am.	....	*
26	Fallawater	l	r c	g y	g	M	W	Am.	....	*
27	Fall Harvey	l	r ob	g y	g	M	L A	Am.	....	*
28	Fall Jenneting	l	fl	g y	g	M	E A	Am.	†	*
29	Fall Pippin	l	r ob	g y	v g	F M	L A	Am.	....	*
30	Fall Queen, *Haas, Gros Pommier*	m	ob c	y r	g	F M	A	Am.	—	—
31	Fameus, *Snow Apple*	m	r ob	r s	v g	F M	W	F.	**	**
32	Foundling	m	r ob	y r	g	F	A	Am.	†	*
33	Garden Royal	m	r c	y r	b	F	S	Am.	—	*
34	Garden Sweet	m	r ob	y r	v g	K M	A	Am.	...	*
35	Gideon	...	......	....	.....	.....	.....	......	—	—
36	Golden Russet of Western N. Y.	m	r ob	y rus	v g	F M	W	......	....	*
37	Golden Sweet	l	r	g y	v g	F M	S	Am.	....	*
38	Granite (Beauty)	l	r ob	y r	g	F M	W	Am.	....	**
39	Gravenstein	l	r ob	y r	v g	F M	L A	Ger.	—	**
40	Grimes Golden	m	r ob	g y	v g	F	W	Am.	—	*
41	Hayford Sweet	s	r c	y r	g	F M	W	Am.	**	†
42	High Top Sweet, *Sweet June*	s	r	g y	v g	F M	S	Am.	—	*
43	Hubbardston, *Hubbardston Nonesuch*	l	r c	y r	v g	F M	W	Am.	....	**

7, valuable for distant market; worthless for home use. 12, 24 and 36 are often confounded; 36 is the variety most commonly met. 26, handsome, but coarse and of inferior quality in this climate. 39, one of the most valuable autumn varieties.

Apples—Continued.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
44	Hunt Russett	m	r ob	y rus	v g	F M	W	Am.	....	*
45	Hurlbut	m	r ob	y r	g	F M	L A	Am.	....	*
46	Jewett Red, *Jewett's Fine Red*, *Nodhead*	m	r ob	r	g	F M	W	Am.	....	**
47	Late Strawberry, *Autumn Strawberry*	m	r	y r	v g	F M	L A	Am.	....	*
48	Longfield	m	r ob	y r	g	K M	L A	Rus.	†	*
49	Magog Red Streak	...	....	....	....	....	....	....	†	....
50	Maiden Blush	m	r	g y	g	K M	E A	Am.	....	*
51	Mann	m	r ob	y r	v g	F M	W	Am.	—	*
52	McIntosh	m	r ob	y r	v g	F M	W	Am.	....	*
53	Mexico	m	r ob	r s	v g	F M	A	Am.	....	†
54	Milden or Milding	l	fl	y r	v g	F M	E W	Am.	....	*
55	Minister	l	ob	r s	g	K M	L A	Am.	...	*
56	Monroe Sweet	....	....	....	....	....	....	....	†	....
57	Mother	m	r c	y r	b	F M	W	Am.	...	**
58	Munson Sweet, *Orange Sweet*	m	fl	y g	g	K M	L A	Am.	....	*
59	New Brunswick Greening	....	....	....	....	....	....	....	†	....
60	Northern Spy	l	r c	y r	b	F M	W	Am.	—	**
61	Oldenburg, *Duchess of Oldenburg*	m	r ob	y r	g	M	S	Rus.	**	**
62	Peabody Greening	...	.. ..	....	....	....	....	....	—	....
63	Peach (of Montreal)	m	r c	y s	v g	F M	A	F.	*	....
64	Peck Pleasant	m	r	g y	v g	F M	W	Am.	...	*
65	Pewaukee	l	fl	r s	g	F M	W	Am.	*	*
66	Porter	l	ob	g y	b	F M	A	Am.	—	**
67	President	l	r ob	y	g	F	A	Am.	....	*
68	Primate	m	r c	g y	b	F	E A	Am.	...	*
69	Prolific Sweeting	....	....	....	....	....	....	....	†	....
70	Pumpkin Sweet, *Lyman's Pumpkin Sweet*, *Pound Sweet*	l	r ob l	y	g	K M	E W	Am.	....	*
71	Ramsdell Sweet	m	ob	y r	g	K M	L A	.....	....	**
72	Red Astrachan	l	r	y r	g	K M	S	F.	*	**
73	Red Beitigheimer	....	....	....	....	....	....	....	†	†
74	Red Canada, *Old Nonesuch*, *Richfield Nonesuch*, *Steele's Red Winter*	m	r ob	y r	b	F M	W	......	†	*
75	Rhode Island Greening	l	r ob	g y	v g	F M	W	Am.	—	**
76	Ribston, *Ribston Pippin*	m	r	y r	v g	F M	W	Eng.	....	*
77	Rolfe, *Macomber*	m	r c	y r	v g	F M	W	Am.	—	**
78	Rome Beauty	l	r	y r	g	M	L A	Am.	....	†
79	Roxbury Russett	m	r ob	y rus	v g	F M	W	Am.	....	*
80	Russell	l	ob	y	v g	F	E A	Am.	†	†
81	Saint Johnsbury Sweet	....	....	....	....	....	....	.. ...	†	....
82	Saint Lawrence	l	fl	y r	v g	M	A	......	†	*
83	Sarah	l	fl	r s	v g	F M	E A	Am.	.. .	†
84	Scott's Winter	....	....	....	....	....	....	....	†	....
85	Somerset (of Maine)	m	fl	r s	v g	F	S	Am.	....	*
86	Sops of Wine, *Hominy*	m	r	y r	g	K M	E A	Eng.	—	*
87	Stark	l	r c	y r	g	F	W	Am.	...	*
88	Starkey	m	r ob	y r	v g	F M	E W	Am.	....	*
89	Summer Pearmain, *American Summer*	m	ob	y r	b	F	S	Am.	....	*
90	Summer Paradise	l	r	g y	v g	F	E A	Am.	....	*
91	Sutton, *Sutton Beauty*	m	r ob	r s	v g	F M	E W	Am.	....	†
92	Swaar	l	r ob	g y	b	F M	W	Am.	...	†
93	Sweet Bough, *Large Yellow Bough*	l	ob	g y	v g	F M	S	Am.	....	*
94	Sweet Janet	....	....	....	....	....	....	....	....	†

Apples—Concluded.

Number.	Names.	Description.							Valu	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
95	Tetofsky	m	fl c	y r	g	K	S	Rus.	**	*
96	Talman Sweet	m	r	g y	v g	K M	W	Am.	**	—
97	Tompkins King, *King of Tompkins County*	l	r	y r	v g	F M	W	Am.	—	*
98	Twenty Ounce, *Cayuga Red Streak*	l	r	r s	v g	F M	L A	Am.	....	*
99	Wagener	m	r ob	y r	b	F	W	Am.	....	*
100	Walbridge	...	......	......	......	......	......	......	†	....
101	Washington (Strawberry)	l	r c	y r	v g	F M	E A	Am.	....	*
102	Wealthy	m	r ob	r	v g	F M	W	Am.	**	*
103	Westfield (Seek-no-further)	l	r c	y r	b	F M	W	Am.	....	*
104	Williams (Favorite)	m	r c	g y	g	M	S	Am.	—	**
105	Wine, *Hay's Wine, Pennsylvania Red Streak*	l	r	y r	v g	F M	W	Am.	...	*
106	Winesap	m	r	y r	v g	F M	W	Am.	....	*
107	Winthrop Greening	l	ob	g y	g	K M	A	Am.	....	*
108	Wolf River	l	r ob	r	g	F M	W	Am.	....	†
109	Yellow Bellefleur	l	ob	g y	v g	F M	W	Am.	—	**
110	Yellow Transparent	m	r ob	y	g	.....	E S	Rus.	**	*

APPLES—Crabs.

Number.	Names.	Description.							Valu	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Hayden	....	......	....	....	.....	......	......	†	...
2	Hyslop	l	r	r	g	F M	A	Am.	*	*
3	Lady Elgin	l	r ob	y r	v g	F M	L A	Am.	**	....
4	Marengo	l	r fl	y r	g	F M	W	Am.	....	†
5	Montreal Beauty	l	r ob	y r	g	F M	A	Am.	....	*
6	Red Siberian	m	r	r	g	F M	A	F.	....	*
7	Transcendent	l	r ob	y r	g	F M	A	Am.	*	**
8	Van Wyck	....	......	....	....	.....	......	......	....	*
9	Yellow Siberian	m	r	y	g	F M	A	F.	....	*

BLACKBERRIES.

ABBREVIATIONS—*Size*,—l, large; m, medium; s, small. *Form*,—ob c, oblong conic; r c, roundish conical or oval; ob ov, oblong oval. *Color*,—b, black. *Quality*,—g, good; v g, very good; b, best. *Use*,— F M, family and market; M, market. *Season*,—M, medium; E, early; L, late. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Agawam..........................	...	......	.....	......	......	......	......	*	**
2	Ancient Briton..........................	l	ob ov	b	v g	F M	M	Am.	....	†
3	Early Harvest..........................	m	ov	b	g	F M	V E	Am.	...	—
4	Erie..........................	l	ob ov	b	g	F M	M	Am.	....	†
5	Kittatinny..........................	l	r c	b	b	F M	M	Am.	....	—
6	Lawton, *New Rochelle*..........................	l	ov	b	g	M	L	Am.	....	—
7	Minnewaski..........................	l	ov	b	g	M	M	Am.	....	†
8	Snyder..........................	m	r ov	b	v g	F M	E	Am.	†	**
9	Stone (Hardy)..........................	l	ob	b	g	F	.....	Am.	....	†
10	Taylor, *Taylor's Prolific*..........................	l	......	b	g	F M	......	Am.	....	†
11	Tree, *Child's Ever-bearing Tree*..........................	....	......	.....	......	......	......	......	....	—
12	Wauchusett..........................	m	ob ov	b	v g	F M	M	Am.	....	—
13	Wilson (Early)..........................	l	ob ov	b	v g	M	E	Am.	....	*
14	Wilson Junior..........................	l	ob ov	b	v g	M	E	Am.	....	†

DEWBERRIES.

ABBREVIATIONS.—Same as for blackberries.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Lucretia..........................	l	ob ov	b	v g	F M	V E	Am.	....	†
2	Windom..........................	....	......	.....	......	......	......	......	†	†

CHERRIES.

ABBREVIATIONS.—*Size,*—l, large; m, medium; s, small. *Form,*—ob h, obtu
heart shape; r ob h, roundish obtuse heart shape; r h, roundish heart shape;
roundish or round. *Color,*—l r, lively bright red; d r, dark red, almost blac
a m, amber mottled with red; y r, yellow ground, shaded and marbled with re
Use,—F, family, for dessert: F M, family or market; K M, cooking or market;
market. *Season,*—E, early; M, medium; L, late. *Origin,*—F, foreign; Am, America

Number.	NAMES.	DESCRIPTION.						VALU
		Size.	Form.	Color.	Use.	Season.	Origin.	North.
	HEARTS AND BIGARREAUS.							
1	Bigarreau, *Graffion, Yellow Spanish*	l	ob h	y r	F M	M	F	....
2	Black Heart	l	r h	d r	F M	M	F	...
3	Black Tartarian	l	r h	d r	F M	M	F	....
4	Coe's Transparent	m	r	a m	F	M	Am	....
5	Downer's Late	m	r h	y r	F M	L	Am	....
6	Early Purple, *Early Purple Guigne*	m	r h	d r	F M	E	F	...
7	Elton	l	r h	y r	F M	M	F	....
8	Governor Wood	l	r h	y r	F M	M	Am	..
9	Napoleon	l	r ob h	y r	F M	M	F	....
10	Windsor	l	r h	d r	M	L	Am	....
	DUKES AND MORELLOS.							
41	Choisy	m	r	a m	F	M	F	....
12	Early Richmond	s	r	l r	K M	E	F	....
13	Hortense	l	r	l r	F M	L	F	....
14	Late Duke	l	ob h	d r	K M	L	......	...
15	Louis Phillippe	l	r	d r	K M	L	F	....
16	Magnifique	l	r h	l r	K M	L	F	....
17	May Duke	l	r ob h	d r	K M	E	F	....
18	Montmorency, Large	l	r	d r	K M	M	F	....
19	Montmorency, Ordinaire	....	.....	....	.....	....	......	....
20	Morello, *English Morello, Large Morello*	l	r h	d r	K M	L	F	....

CURRANTS.

Abbreviations.—*Size,*—l, large; m, medium; s, small. *Form,*—with reference to form of bunch,—l, long; v l, very long; s, short; m, medium. *Color,*—r, red; b, black; w, white. *Quality,*—a, acid; m a, moderately acid; v a, very acid. *Use,*—K M, kitchen and market; F M, family and market; M, market. *Season,*—E, early; M, medium; L, late. *Origin,*—Am, American; F, foreign.

Number.	Names.	Description.							Value.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Black Naples	l	s	b	m a	K M	M	F	....	*
2	Cherry	l	s	r	v a	M	M	F	*	*
3	Fay, *Fay's Prolific*	l	l	r	m a	F M	M	Am	**	**
4	Lee, *Lee's Prolific*	l	l	b	m a	K M	M	F	....	*
5	Moore Ruby	m	....	....	....	....	....	....	....	†
6	Prince Albert	l	l	r	m a	M	L	F	....	*
7	Red Dutch	m	m	r	m a	F M	E	F	*	*
8	Versaillaise, *La Versaillaise*	l	s	r	a	M	M	F	....	**
9	Victoria, *Raby Castle*	l	v l	r	a	F M	L	F	....	*
10	White Grape	m	l	w	m a	F M	E	F	**	**

GOOSEBERRIES.

Abbreviations.—*Size,*—l, large; m, medium; s, small. *Form,*—r, round; o, oval; r o, roundish oval. *Color,*—r, reddish when fully ripe: g, greenish yellow when fully ripe. *Quality,*—g, good; v g, very good; b, best. *Use,*—K, kitchen; M, market. *Season,*—E, early; M, medium; M L, medium-late. *Origin,*—Am, American; F, foreign.

Number.	Names.	Description.							Value.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Downing	m	r o	g	v g	K	M L	Am	*	**
2	Houghton	s	r o	r	g	K M	E	Am	**	**
3	Industry	l	r o	r	v g	K	M	F	....	†
4	Smith, *Smith's Improved*	l	o	g	v g	K M	M	Am	*	*
5	Whitesmith	l	o	g	v g	K M	M	F	....	†

GRAPES.

ABBREVIATIONS.—*Size*,—with reference to the berry,—l, large; m, medium; small. *Form*,—with reference to bunch and berry,—s r, short bunch, round berr l r, large and round; m r o, medium bunch, roundish-oval berry; m r, mediu bunch, round berry. *Color*,—b, black, or nearly so when fully ripe; r, reddish, coppery-brownish red; g, greenish-white or yellowish. *Quality*,—g, good; v very good; b, best. *Use*,—T, table; M, market; W, wine. *Season*,—E, early; medium; L, late. *Origin*,—the species to which each variety belongs; Lab, *Vit Labrusca*; Æst, *æstivals*; Rip, *Riparia*; Vulp, *Vulpina*. An X after one of the specie denotes a cross with a variety of some other species. Hyb, hybrid between foreign variety and one of the native species.

Number.	NAMES.	DESCRIPTION.							VALU
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.
1	Agawam, *Rogers' No. 15*	l	s r o	r	g	T M	M	Hyb	....
2	Brighton	l	r	d r	v g	T	E	Hyb	....
3	Concord	l	l r	b	g	T M W	M	Lab	....
4	Delaware	s	s r	r	b	T M W	M	? X	....
5	Diana	m	s r o	r	v g	T M	L	Lab	....
6	Green Mountain	....	.....	....	....	....	....	....	...
7	Hartford, *Hartford Prolific*	l	m r o	b	g	M	E	Lab	....
8	Iona	m	m r o	r	b	T M W	L	Lab	....
9	Moore's Early	l	r	b	g	T M	V E	Lab	....
10	Niagara	l	r	w	g	T M	M	Lab	....
11	Salem, *Rogers' No. 52*	l	r	b	g	M	M	Hyb	....
12	Wilder, *Rogers' No. 4*	l	l r	b	v g	T M	M	Hyb	....
13	Worden	l	r	b	g	T M	E	Lab	....
14	Wyoming	....	.....	....	....	....	....	....	....

QUINCES.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small; v, very. *Form*,— oblate; ob, obtuse: p, pyriform; r, roundish. *Color*,—g, greenish; y, yellowis *Quality*,—h, half tender; t, tender. *Use*,—K, kitchen; M, market. *Season*,— early; L, late. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALU
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.
1	Alaskan	....	......	....	...	....	......	.....	....
2	Angers	v l	r ob p	y	t	M K	E L	F	....
3	Apple or Orange	l	r	y	h t	M K	E L	......	....

PEARS.

ABBREVIATIONS.—*Size*,—s, small; l, large; m, medium. *Form*,—p, pyriform; r o p, roundish obtuse pyriform: r a p, roundish acute pyriform; ob p, obtuse pyriform; ob o p, oblong obtuse pyriform; r, roundish; r ob, roundish obtuse. *Color*,—y g, yellow or yellowish green with a red or russet red cheek; y r, yellow and russet; y, when mostly yellow or yellowish. *Quality*,—g, good; v g, very good; b, best. *Use*,—F, valuable family dessert: K M, kitchen and market; F M, family and market. *Season*,—S, summer; L S, late summer; A, autumn; E A, early autumn; W, winter. *Origin*,—Eng, English; Am, American; F, Flemish; B, Belgium; H, Holland.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Admiral Farragut	l	r a p	y g	g	K M	A	Am	....	†
2	Angouléme, *Duchesse d' Angouleme*	l	ob o p	y	v g	F M	A	F	....	**
3	Anjou, *Beurre d' Anjou*	l	ob p	y g	v g	F M	L A	F	....	**
4	Bartlett	l	ob o p	y	v g	F M	L S	Eng	....	**
5	Bosc, *Beurre Bosc*	l	p	y r	b	F M	L A	B	....	*
6	Boussock, *Doyenne Boussock*	l	r o p	y r	v g	F M	E A	B	..	*
7	Buffum	m	r o p	y g	g	M	E A	Am	....	*
8	Clairgeau, *Beurre Clairgeau*	l	p	y r	g	M	L A	F	...	*
9	Clapp Favorite	l	ob o p	y g	v g	F M	S	Am	....	**
10	Diel, *Beurre Diel*	l	r ob p	y r	v g	F M	L A	B	....	*
11	Easter Beurre	l	r ob p	y r	v g	F	W	B	....	†
12	Eastern Belle	m	ob p	y r	v g	F	E A	Am	....	*
13	Flemish Beauty	l	r ob p	y g	v g	F M	E A	B	....	—
14	Fulton	s	r ob	y r	v g	F	A	Am	....	*
15	Giffard	m	p	y g	v g	F M	S	F	...	*
16	Goodale	l	ob p	y g	v g	F M	A	Am	....	†
17	Hardy, *Beurre Hardy*	l	ob p	y g	v g	F M	E A	......	....	*
18	Howell	l	r p	y g	v g	F M	E A	Am	....	*
19	Indian Queen	l	p	y g	g	K M	A	Am	....	†
20	Josephine of Malines	m	r ob p	y r	v g	F M	W	F	...	*
21	Lawrence	m	r o p	y r	v g	F M	W	Am	....	**
22	Louise Bonne of Jersey	l	ob p	y g	v g	F M	E A	F	....	**
23	Lucrative, *Belle Lucratire*	m	ob r	y g	b	F	E A	Fl	....	**
24	McLaughlin	l	ob p	y g	v g	F M	W	Am	....	*
25	Nickerson	l	ob p	y g	g	F M	A	Am	*	†
26	Onondaga, *Swan's Orange*	l	ob p	y g	v g	F M	L A	Am	....	*
27	Rostiezer	s	p	y g	b	F	S	....	....	*
28	Seckel	s	r	y g	b	F M	A	Am	....	*
29	Sheldon	m	r	y g	v g	F M	A	Am	....	**
30	Souvenir du Congres	l	p y r	y g	v g	F M	S	F	....	†
31	Summer Doyenne, *Doyenne d' Ete*	s	r o p	y g	v g	F	S	B	....	*
32	Superfin, *Beurre Superfin*	m	r p	y r	v g	F	A	F	....	*
33	Tyson	m	r a p	y g	b	F	S	Am	....	*
34	Vicar, *Vicar of Winkfield, Le Cure*	l	p	y	g	K M	W	F	....	*
35	Winter Nelis	m	ob p	y r	b	F M	W	B	..	*

PLUMS.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small. *Form*,—o, oval; ob, obovate; r, roundish. *Color*,—g, greenish; p, purplish; r, reddish; y, yellow. *Quality*,—g, good; v g, very good; b, best. *Use*,—F, family; M, market. *Season*,—E, early; L, late; M, medium. *Origin*,—Am, American; F, foreign.

Number.	Names.	Description.							Value.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
1	Abundance	m	r o	p	g	F M	M	Jap	....	†
2	Bavay, *Bavay's Green Gage*	l	r	g y	b	F	L	F	...	**
3	Bleeker Gage	m	r o	y	v g	F M	M	Am	...	*
4	Burbank	m	r	p	g	F M	M	Jap	....	†
5	Bradshaw	l	o ob	r p	g	M	M	Am	....	*
6	Coe Golden Drop	l	o	y r	v g	F M	L	F	....	*
7	Columbia	l	r	p	g	M	M	Am	....	*
8	Damson	s	o	p	g	M	L	Am	*	*
9	De Soto	m	r o	y r	v g	F M	M	Am	†	†
10	Duane Purple	l	o	r p	g	F M	E	Am	....	*
11	Forest Garden	m	r	r	v g	F M	E	Am	†	†
12	Green Gage	s	r	g y	b	F	M	F	*	*
13	Huling, *Huling Superb*	l	r o	g y	g	F M	M	Am	....	*
14	Imperial Gage	l	o	g y	b	F M	M	Am	.	**
15	Italian Prune, *Fellemburg*	m	o	p	g	F M	M	F	...	*
16	Jefferson	l	o	y r	b	F M	M	Am	...	*
17	Lombard	m	r o	r p	g	M	M	Am	—	*
18	McLaughlin	l	r	y r	b	F M	M	Am	....	**
19	Moore Arctic	m	r o	p	g	F M	M	Am	**	*
20	Penobscot	...	....	....	....	.. ...	....	Am	....	*
21	Pond, *Fonthill*	l	o	y r	g	M	M	F	....	*
22	Purple Gage	m	r	p	v g	F M	M	.....	....	*
23	Quackenboss	l	r	p	g	M	M	Am	....	*
24	Rollingstone	....	....	....	....	... .	....	Am	†	†
25	Shropshire Damson	s	o	p	g	F M	L	Eng	....	*
26	Smith Orleans	l	o	r p	v g	F M	M	Am	*	*
27	Washington	l	r o	g y	v g	F M	M	Am	....	*
28	Wolf	m	o	y r	g	F M	M	Am	†	†
29	Yellow Egg, *White Magnum Bonum*	l	o	y	g	F M	M	......	....	*

1 and 4 Japanese varieties which can succeed only in the southern parts of the State. 9, 11, 24 and 28, improved varieties of *Prunus Americana*, the native "horse plum" or "pomegranate." 19, the most popular variety for Aroostook county.

RASPBERRIES.

ABBREVIATIONS.—*Size*,—l, large; m, medium; s, small; v, very. *Form*,—c, conical; o, obtuse; r, roundish. *Color*,—b, black; p, purplish; r, reddish; y, yellow. *Quality*,—b, best; g, good; v, very. *Use*,—M, market; F, family. *Season*,—E, early; L, late: M, medium. *Origin*,—Am, American; F, foreign.

Number.	NAMES.	DESCRIPTION.							VALUE.	
		Size.	Form.	Color.	Quality.	Use.	Season.	Origin.	North.	South.
	SUB-SECTION I.—RUBUS IDÆUS.									
1	Clarke	m	r	r	g	F M	E	Am	....	*
2	Herstine	l	ob c	r	v g	F M	M	Am	....	†
3	Knevett	l	ob c	r	b	F	M	F	...	—
4	Orange, *Brinckle's*	l	c	y	b	F	M	Am	....	—
	SUB-SECTION II.—R. NEGLECTUS.									
1	Philadelphia	m	r	p	g	M	M	Am	....	—
2	Shaffer	v l	r	p	g	F M	M	Am	....	*
	SUB-SECTION III.—R. OCCIDENTALIS.									
1	Gregg	v l	r	b	g	F M	M	Am	....	**
2	Hilborn	....	......	....	....	......	....	......	....	†
3	MacCormick, *Mammoth Cluster*	m	ob c	b	v g	F M	L	Am	....	*
4	Nemeha	....	......	....	....	......	....	......	....	†
5	Souhegan	m	r	b	g	F	E	Am	...	*
6	Tyler	m	r	b	v g	F M	E	Am	....	*
	SUB-SECTION IV.—R. STRIGOSUS.									
1	Cuthbert, *Queen of the Market*	l	r o	r	g	F M	M	Am	....	**
2	Golden Queen	l	r c	y	v g	F M	M	Am	....	**
3	Hansell	m	r c	r	v g	F M	V E	Am	....	†
4	Marlboro	l	r c	r	g	F M	M	Am	....	*
5	Turner	m	r	r	g	F M	E	Am	....	*

STRAWBERRIES.

Abbreviations.—*Size*, l, large; s, small; m, medium. *Sex*,—B, bisexual; P, pistillate; P B, nearly pistillate. *Color*,—d c, deep crimson; d s, deep scarlet; b s, bright scarlet; w t, whitish tinted with red; l c, light crimson. *Form*,—r c, roundish conical; o c, obtuse conical or coxcomb form; c, conical; r, roundish; r o c, roundish obtuse conical. *Flesh*,—s, soft; f, firm; m, medium. *Season*,—E, early; M, medium; L, late; E L, early to late. *Origin*,—Am, American; F, foreign.

Number.	Names.	Description.							Value.	
		Size.	Sex.	Color.	Form.	Flesh.	Season.	Origin.	North.	South.
1	Beeder Wood	....	....	......	.....	....	......	......	....	†
2	Beverly	....	....	......	.....	....	......	......	....	†
3	Boynton	....	..	......	.....	....	......	......	....	†
4	Bubach No. 5	....	P	......	.....	....	......	Am	*	*
5	Burt	....	....	......	.....	....	......	......	....	†
6	Charles Downing	l	B	d s	o	f	M	Am	*	*
7	Col. Cheney	l	P	b s	o c	f	M	Am	...	*
8	Crawford	l	B	b c	o c	m	M	Ohio	...	†
9	Crescent	l	P	b s	r c	m	M	Am	**	**
10	Cumberland, *Cumberland Triumph*	v l	B	b s	r c	s	M	Am	....	*
11	Gandy	....	B	b r	c	f	......	Am	....	†
12	Haverland	l	P	r s c	o c	m	M	Am	....	**
13	Jessie	v l	B	b s	r c	m	M	Am	....	*
14	Manchester	l	P	s	o c	f	M	Am	....	*
15	May King	....	....	......	.....	....	......	......	....	*
16	Michel's Early	....	..	......	.....	...	......	......	....	†
17	Miner, *Miner's Great Prolific*	v l	B	c	r c	m	M	Am	....	*
18	Monmouth	....	....	......	.....	....	......	......	..	†
19	Mrs. Cleveland	....	....	......	.....	....	......	......	....	†
20	Parker Earle	l	B	b r	l c	f	M	Tex	....	†
21	Pearl	m	B	d r	o c	f	M	Am	....	†
22	Sharpless, *Ontario*	v l	B	b r	o c	f	M	Am	....	*
23	Triomphe de Gand	l	B	l c	o c	f	M	F	....	*
24	Warfield	m	P	d r	c	f	M	Ill	....	†
25	Wilson, *Wilson's Albany*	l	H	d c	r c	f	E L	Am	....	*

SELECT VARIETIES.

1. *For the Northern Counties.*

APPLES—*Summer and Autumn.* Yellow Transparent, Oldenburg, Alexander, Lady Elgin crab. *Winter.* Dudley's Winter (North Star,) Fameuse, Hayford Sweet, Wealthy.

PEARS—Fulton, Eastern Belle, Nickerson, Tyson, Vermont Beauty.

PLUMS—Moore Arctic, Green Gage, Smith's Orleans, and possibly De Soto. Forest Garden and Wolf.

SMALL FRUITS—Agawam blackberry; Cuthbert, Turner and Tyler raspberries; Fay and White Grape currants; Downing and Houghton gooseberries.

2. *For the Southern Counties.*

APPLES—*Summer and Autumn.* Yellow Transparent, Oldenburg, William's Favorite, Dyer (Pomme Royal,) Gravenstein, Fall Harvey, High Top Sweet, Munson Sweet, Ramsdell Sweet.

Winter—Baldwin, Fameuse, Granite Beauty, Hubbardston, Jewett Red (Nodhead), Milding, Mother, Northern Spy, Rhode Island Greening, Rolfe, Roxbury Russet, Talman Sweet, Wealthy, Yellow Bellflower.

PEARS—Clapp Favorite, Bartlett, Louise Bonne of Jersey, Sheldon, Angouleme, Anjou, Lawrence.

PLUMS—Bavay, Imperial Gage, Lombard, McLaughlin.

CHERRIES—Black Heart, Downer's Late, Governor Wood, Early Richmond, English Morello.

RASPBERRIES—Cuthbert, Golden Queen, Shaffer, Gregg.

BLACKBERRIES—Agawam, Snyder.

CURRANTS—Fay, Prince Albert, Versaillaise, Victoria, White Grape.

GOOSEBERRIES—Downing, Smith, Whitesmith.

GRAPES—Green Mountain, Hartford, Moore's Early, Worden.

STRAWBERRIES—Bubach No. 5, Crescent, Haverland, Sharpless, Wilson.

* 3. *Select Apples for Home Use.*

Summer and Autumn: Yellow Transparent, Oldenburg, Dyer, Gravenstein, High Top Sweet, Munson Sweet.

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*The varieties here suggested are known by the writer to be of value for the purposes named in certain parts of the State. There may be some sections where local conditions would render other sorts more valuable.

Winter—Fameuse, Hubbardston, Mother, Northern Spy, Rhod Island Greening, Rolfe, Roxbury Russet, Winter Sweet Paradise Talman Sweet.

*4. *Select Apples for Market.*

Summer and Autumn: Oldenburg, Gravenstein, High Top Sweet

Winter—Baldwin, Ben Davis, Hubbardston, Rhode Island Greening, Roxbury Russet, Talman Sweet, Yellow Bellflower.

5. *Apples Tried and Found Wanting in the Northern Counties.*

Baldwin, Ben Davis, Black Oxford, Blue Pearmain, Fall Queen (Haas), Gravenstein, Grimes Golden, High Top Sweet, Manu Northern Spy, Peabody Greening. Porter, Rhode Island Greening Rolfe, Sops-of-Wine, Talman Sweet, Tompkins King, William (Favorite), Yellow Bellflower.

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*See note on page 143.

Report of Botanist and Entomologist.

Prof. F. L. Harvey.

Professor W. H. Jordan:

Dear Sir—I have the honor to submit herewith my sixth annual report as Botanist and Entomologist for the Experiment Station. The demand for information about injurious fungi, weeds, forage plants and injurious insects is increasing. More letters of inquiry were received the past season than ever before. Many of these letters were about insects and fungi already considered and figured in previous reports and from parties who must have had access to the Station Reports. It is apparently less trouble to send specimens to the Station for examination and positive determination than to look them up in the reports. Extensive and carefully detailed correspondence must form an important feature of Station work. Such letters are usually answered by referring to the published accounts in the Station Reports. Specimens when new to the State are reported upon in detail, and if of sufficient interest are considered and figured in the annual report. Below will be found tabulated and considered the most important plants and insects that have been studied the past season The season has not been marked by the extreme ravages of any insect, or the widespread prevalence of any species of fungus, though some of those that gave trouble last season have increased and a few have been added to the list of our State pests.

Pear-Leaf Blight seems to be spreading in the western part of the State in the vicinity of Portland. Any whose pears crack open in ripening will do well to read the article on this disease in Experiment Station Report, 1892, page 109. The Bean Anthracnose, a disease that causes brownish spots upon snap beans, (especially the white-podded varieties), was quite prevalent the past season. Tomato Anthracnose, a fungus attacking ripening and ripe tomatoes was abundant in the Station garden and elsewhere in the State. The Beet Scab, a disease causing warty excrescences upon beet roots, and said to be produced by the same fungus as Potato Scab was abundant in the Station garden and other places in the State. The Clover Rust was unusually bad (especially on second-growth clover,) about Orono. A new tomato disease causing depressed dark patches upon ripened tomatoes did considerable damage to tl Station tomato crop. The STRAWBERRY SEPTORIA was very abunda upon Station strawberries. The ORANGE HAWK-WEED still spread As it seeds before harvest, spreads by runners at the roots and perennial it will yield to nothing but the spade and hoe, and tl earlier attended to the less trouble. The ARISTATE PLANTAIN, a ne relative of the ENGLISH PLANTAIN has made its appearance in tl State. In response to an enquiry regarding wild rice we ha learned that it is plentiful in the State.

THE FALL CANKER WORM is gradually spreading. Besid apparently holding its own in known localities several new localiti have been reported the past season. This species is sometim accompanied by the LIME-TREE WINTER-MOTH an insect similar in i habits but checked by spraying like the CANKER-WORM

THE ANGOUMOIS GRAIN MOTH was found in great numbers in box of *Shaker Pop Corn* offered for sale in Orono. This is one of tl worst grain insects. The grain exhibits at the World's Fair we badly infested with it. It is capable of doing much damage stored grain and its spread in the State would be a misfortune.

THE STALK BORER, (*Gortyna nitela*, Guen.,) and THE BLACK CA THARIS, (*Cantharis atrata*,) were both reported as doing damage potatoes; the former boring into the stalks, the latter in great nu bers feeding upon the foliage.

THE RED-HUMPED APPLE TREE CATERPILLAR seems to be increa ing in the State. It was reported from a new locality this seaso and we found it also in the Station orchard, probably introduced nursery stock.

THE APPLE-LEAF BUCULATRIX, (*B. pomifoliella*, Clemens.) A sma moth, the larva of which skeletonizes the leaves of apple trees w reported as doing considerable damage. This insect has not be noticed before.

Specimens of pears received from F. Frank Jones, Portland, bo the characteristic cuts of the PLUM CURCULIO. Some of the frui had five incisions and were badly dwarfed and distorted.

THE STRIPED SQUASH BEETLE, a very common garden pest seems have been unusually abundant the past season. Thick plantin and then thinning, as the plants get older; protecting the seedlin by boxes or half hoops and netting, or even hand picking the beetl will usually insure a good stand of cucurbitaceous plants.

Mr. C. A. Wood of Searsport sent us a species of ROVE BEETLE, *Ancyrophorus planus*, and THE FOUR-SPOTTED PITHYOPHAGUS, *P. 4-guttatus*. Both were accused of destroying the kernels of sweet corn at the top of the ear. Ears of damaged corn accompanied the accused. We were able to acquit the above beetles as the corn showed the unmistakable work of the CORN WORM which was considered in our last report on P. 119. The true culprits, full fed, had probably crawled away to transform. The above insects were in the corn to feed upon the sugary and starchy matter that flowed from the broken kernels.

THE WHITE GRUB or larva of the MAY BEETLE, *Lachnosterna fusca*, has been doing much damage to grass lands in the vicinity of Bridgton. As there is no certain remedy known for this insect it would be advisable to do some field work upon it and try the most hopeful remedies suggested by entomologists and prove their value or worthlessness.

THE PEAR BLIGHT BEETLE working in the limbs of apple trees and boring the wood full of small channels is a new injurious insect to the State.

We reeceivd specimens from two widely separated localities so it must be widespread. Its presence can be detected by small shot-like holes in the bark. It attacks healthy trees and there is no remedy but to cut the branches infested and burn them.

The BEAN WEEVIL spoken of in our last report is considered and illustrated in this. The HORN FLY was quite abundant in some localities. It is migrating eastward and was quite abundant at Hudson and other localities in the Penobscot valley this season.

The CARROT FLY, *Psila rosæ*, was received from Mr. C. H. Morrell, Pittsfield. It was found infesting stored carrots. This is a European insect never before detected in the United States. The carrots were literally alive with maggots.

Beets in this region were badly infested by a species of *Anthomyia* or BEET FLY, the larvæ of which eat the pulp from the leaves, leaving the epidermis. The eaten spots are clear whitish and in them the maggots can often be seen between the epidermi.

THE CURRANT PLANT LOUSE, *Aphis ribes*, L. has been doing damage to gooseberries in Aroostook and Piscataquis counties the past season, destroying the foliage and causing a second growth of small leaves.

THE APPLE MAGGOT, *Trypeta Pomonella*, Walsh, still is doi much damage in Maine as well as in adjoining states, if we c judge from the demand for our article on this insect, published the Station Report for 1889. We received a long newspaper arti from a New Hampshire correspondent, which he had written to gi the fruit growers of his state the life history of this pest. T article was accompanied by specimens in the "*long-winged*" sta of their development, graphically described by the writer. T specimens were a species of ICHNEUMON which does not even belo to the same order as Trypeta, which is a *two winged* fly. The artic was full of other errors. We notice this merely to warn farme and fruit growers against articles upon technical subjects by no professionals. To trace the life history of an insect requires gre care, and a knowledge of insect forms that can not possibly obtained except by long experience.

In the above mentioned article at least *three insects* belonging *different orders* were regarded as *stages* in the life history of *Tryp* and *none of them pertained to that insect* The best way is to se injurious insects to the professional entomologist. *Absolute* iden fication of a pest is the first thing necessary in coping with it.

THE CHINCH BUG still continues to do damage to meadow lan in the vicinity of Fryeburg. It will be well to do some field work that region another season to learn the extent of the infested distri and gain any information that will enable us to suggest remedi measures.

Tetranychus 2-maculatus, Harvey, was reported from Piscataqu county the past season. While we were in Chicago, durin July, specimens of this mite were submitted to us for examinatio They came from a greenhouse near Chicago, showing this pest widely distributed.

DIRECTIONS FOR SENDING SPECIMENS.

Regardless of the careful directions given in previous repor for sending insects, several specimens were received the past seaso in envelopes or fragile paper boxes and when they arrived we crushed almost beyond recognition. Other packages came witho the name and address of the sender upon them. Insects shou *always* be sent in wooden or tin boxes and some of the food pla or injured material enclosed. Notes upon the habits of the inse should accompany the specimens, and the sender's name and address should be upon the package even if a separate letter is written. We sometimes receive several packages the same day and if not plainly marked we are unable to tell from whom they come.

Directions for sending specimens will be found in the Annual Report of the Experiment Station, 1888, p 194, or in Maine Agricultural Report, 1888. p. 158. Correspondence regarding injurious insects and fungi is invited. Insects and plants will be named, and when injurious, remedies suggested. It is to the interest of farmers to detect injurious insects and fungi before they become established, so that remedial measures can be adopted before the pests are beyond control. As the Entomologist's duties prevent him from going much about the State, it is largely through correspondence that the Station learns of insects doing injury in the State

REMARKS.

The cuts and plates to illustrate this Report were obtained from the following sources: From the Department of Agriculture, Washington, D. C.; the plate of Plantago Patigonica, cuts of the Angoumois Grain Moth, and cuts of the May Beetle; from J. B. Lippincott & Co.; cuts of the Lime-tree Winter-moth, the Apple-leaf Bucculatrix, the Disippus Butterfly and the Pear-blight Beetle; from Prof. A. E. Popenoe, cuts of the Bean and Pea Weevils; cuts of the bean Anthracnose and Carrot Fly are from original drawings made by the writer.

PLANTS REPORTED AND EXAMINED—1893.

No.	COMMON NAME.	TECHNICAL NAME.	FROM WHOM RECEIVED.	REMARKS.
1	HAIR MOLD	*Phycomyces mitens*	Chas. P. Kitridge, Milo	On excrement. See Experiment Station Report, 1892, p. 111.
2	PEAR-LEAF BLIGHT	*Entomosporium maculatum*, Lev.	T. Frank Jones, Portland	Attacking the leaves and fruit of pear trees. See Experiment Station report, 1892, p. 109.
3	BEAN ANTHRACNOSE	*Colletotrichium Lyndemuthianum*, (S and M) (B and Cav.)	Eugene T. Perkins, Kennebunkport Prof. W. H. Jordan, Orono	Causing brown spots on the pods of beans.
4	ANTHRACNOSE OF THE TOMATO	*Colletotrichum phomoides*, Sacc.	F. L. Harvey, Orono	Causing ripe rot on tomatoes.
5	BEET AND POTATO SCAB	*Oospora scabies*, Thaxter	F. L. Harvey, Orono	Causing warty excrescences on beet roots and scab on potatoes.
6	ORANGE HAWKWEED	*Hieracium aurantiacum*, L.	E. W. Dutton, New Sharon	Coming uninvited into fields.
7	ARISTATE PLANTAIN	*Plantago Patigonica* var. *aristata*, Gray.	Mrs. A. M. Pikes, East Madison	In oat field.

INSECTS REPORTED AND EXAMINED—1893.

No.	COMMON NAME.	TECHNICAL NAME.	FROM WHOM RECEIVED.	REMARKS.
1	FALL CANKER WORM.	*Anisopteryx pometaria*, Harris	B. Walker McKeen, Augusta, Chas. S. Pope, Manchester, W. F. Hilt, Warren, Samuel Milliken, W. Scarboro	Eggs on apple trees; wingless females on side of house; larvæ feeding on foliage of apple trees.
2	THE ANGOUMOIS GRAIN MOTH	*Gelechia cerealella*, L	F. L. Harvey	Found in *Sure Pop* Shaker Corn in a store in Orono.
3	THE STALK BORER	*Gortyna nitela*, Guen	H. B. Whipple, Bingham	Boring potato stalks.
4	THE IO EMPEROR MOTH	*Hyperchiria Io* (Linn)	F. H. Parlin, East Winthrop	
5	THE LIME-TREE WINTER MOTH	*Hybernia tillaria*, Harris	F. W. Hilt, Warren	With the females of the Fall canker worm crawling on the side of a house.
6	THE RED-HUMPED APPLE-TREE CATERPILLAR	*Œdemasia concina*, (Sm. and Abb.)	F. L. Harvey, College orchard, Miss May Thurlow Farrow, Centre Belmont	Feeding on foliage of apple trees. See Station Report, 1890, page 135.

7	THE GREAT AMERICAN TIGER-MOTH	*Arctia Americana*, Pack	D. H. Knowlton, Farmington	This is a rare moth in Maine. Of no special economic importance.
8	THE APPLE-LEAF BUCCULATRIX	*Bucculatrix Pomifoliella*, Clemens.	D. P. Boynton, Monmouth	Injuring the foliage of apple trees.
9	THE DISIPPUS BUTTERFLY	*Limenitis disippus*, Godt	Fred B. Pike, Cornish	Feeding on willows.
10	THE PLUM CURCULIO	*Conotrachelus nenuphar*, Herbst	F. Frank Jones, Portland	Several varieties of pears showing the cuts of the plum curculio.
11	THE STRIPED SQUASH BEETLE	*Diabrotica vittata*, Fabr	J. W. Black, Searsport	Obtained from Mr. C. A. Woods.
12	ROVE BEETLE	*Ancyrophorus planus*, Lec	J. W. Black, Searsport, from C. A. Woods, Searsport	Feeding on the starchy matter of ears of corn that had been injured by the Corn Worm. See Experiment Station Report, 1883, p. 192.
13	FOUR SPOTTED PITHYOPHAGUS.	*Pithyophagus 4-guttatus*	J. W. Black, Searsport, from C. A. Woods, Searsport	With the above feeding upon the exuded milk of corn attacked by the Corn Worm.
14	THE WHITE GRUB OR MAY BEETLE	*Lachnostema fusca*, Trohl	J. L. Wale, Bridgton	Destroying meadows.
15	BLACK CANTHARIS	*Cantharis atrata*	H. B. Gray, Blue Hill	Feeding on potato vines.
16	BEAN WEEVIL	*Bruchus obtectus*, Say	Samuel Libby, Orono	Working in stored beans.
17	THE PEAR BLIGHT BEETLE	*Xyleborus pyri*, Peck,= *Xyleborus dispar*, Fabr	J. M. Allen, North Sedgwick, Dr. Twitchell, Augusta	Boring in the limbs of apple trees.
18	THE HORN FLY	*Haematobia serrata*	A. T. Wing, North Fayette	See Experiment Station Report, 1892, p. 131.
19	THE CARROT FLY	*Psila rosae*, Fab	C. H. Morrell, Pittsfield	Larvæ badly infesting stored carrots. New to United States.
20	THE BEET OR MANGOLD FLY	*Anthomyia betae*, Curtis	O. T. Goodrich, Orono, F. L. Harvey, Orono	Feeding on the pulp of beet leaves reducing them to a dry papery skin.
21	OYSTER-SHELL BARK-LOUSE	*Mytilaspis pomorum*, Bouchè	Miss Georgine V. Wilbur, Phillips	On apple trees. See Experiment Station Report, 1888, p. 157.
22	THE CURRANT PLANT LOUSE	*Aphis ribis*, L	Chas. P. Kittredge, Milo Delano Moore	Attacking gooseberry leaves. Causing clusters of second growth leaves.
23	THE COTTONY MAPLE SCALE	*Pulvinaria innumerabilis*, Rathvon	C. M. Randlette, Richmond	On maple leaves.

BOTANY.

BEAN ANTHRACNOSE.

Colletotrichium Lindemuthianum, (Sacc & Magn) Briosa & Cava

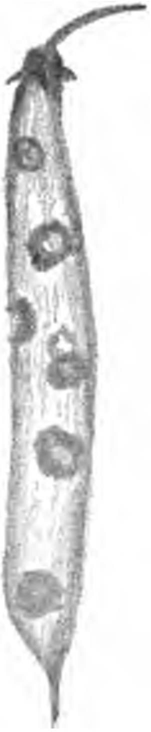


FIG. 1—Bean Anthracnose, pod showing pits formed by the disease (original)

The above disease of the bean has been qu common in gardens and fields about Orono for past seven years and we presume it is preval throughout the State. It was unusually bad past season, and specimens were received from d tant localities and inquiries made regarding it. is probably the worst disease of the bean and as ravages can be largely controlled by proper prec tions and treatment, the following consideration the fungus may prove helpful in combating it. T **BEAN ANTHRACNOSE** is a parasitic fungus attacki the stem, leaves and pods of both bush and p beans, producing, especially on the pods, sunk brownish pits or spots surrounded by a redd brown border. See Fig 1. In the central part these pits are little pinkish dots which are the sp masses that have exuded from below. The spo are held together by a gummy substance that soluble in water and they may be liberated by d or rain or excessive moisture and then are free be blown by the wind to healthy plants, where th germinate and spread the disease. The disease worst upon the white podded bush and pole bea but will also attack the more hardy varieties. T past season it was quite bad upon YELLOW EYES the field. We lost the greater part of our gard crop of German Wax the past season, the pods becoming so cover with pits before they were large enough to pick as to be worthle The effects of this disease are to lessen the stand when it destro the seedlings; to dwarf the plants and make the pods swollen a when it spots the pods to render them unfit for snap beans, also finally injure the bean in the pods. This disease may origin from infected seed or, we think, it may live over winter in t beans and pods that are left in the garden. When infected seed planted the disease shows itself early in the seedlings. Much the seed of German Wax beans offered for sale is infected. T past season fully half of the seedlings in our garden were affect when they appeared above ground and not more than two-thirds of the seed came up. The remaining plants were dwarfed and early showed the presence of the disease. We procured new seed and made a second planting.

We have *purchased* our seed for the past seven years from that offered for sale by prominent dealers and have never had a crop free from the disease. It is common among gardeners to leave the bushes with the diseased pods upon them to rot on the ground, and to plant a second crop in the same place. We practice rotation of crops even in the garden with good results. It is a good practice to clear a garden in the fall of all refuse and carefully burn it. By doing this, fungi that live in the decaying organic matter are destroyed, along with hybernating insect pests. Beans should be planted on a light dry soil, in hills, or if in rows far enough apart to give good circulation of air. Moisture favors the growth of *Anthracnose* and other bean diseases. Care should be taken not to hoe beans after a rain or when the dew is on for the dirt that sticks to the leaves is liable to contain spores that will germinate and rapidly spread the disease. Professor Jordan showed us some badly spotted pods that were apparently free from the disease when purchased in the Orono market a day or two before.

If possible secure seed from your own, or a neighbor's field that was free from disease. It is hazardous to p'ant seed from an infested field. If obliged to take seed from a field that has been diseased pains should be taken to select pods from plants that have escaped the disease. All beans that show sunken pits, discolored patches, or are even wrinkled or blistered should be rejected. Diseased seedlings should be pulled as early as possible and removed from the field or burned, as the fungus will ripen its spores in the decaying plant. Some practice spraying beans with *Bordeaux mixture* early in the season, and claim that the fungus is controlled by it. The following precautions should materially lessen the disease:

I. Select good seed, rejecting all beans that seem at all unsound.

II. Should the disease appear in the young beans carefully destroy all affected seedlings.

III. If convenient spray early with Bordeaux mixture and repeat the application if needed before the pods form.

IV. Do not plant on ground that has borne an infected crop the past season.

V. Plant on a dry soil in hills or in rows far enough apart to admit air freely. Hoe when the ground and foliage are dry.

TOMATO ANTHRACNOSE.

Colletotrichum phomoides, Sacc.

This fungus appeared last fall in the station garden upon ripe ing and fully ripe tomatoes and did considerable damage. Tom toes that were apparently sound developed the disease rapidly aft they were gathered. This fungus is capable of doing much damag to the ripening crop and the ripe fruit can not be kept any time marketed. We understand from Professor Munson that the diseas has done damage elsewhere in the State. Professor Chest described this fungus as *C. lycopersici*, n. s p. in the Fourth Repo of the Delaware Station, but in the Fifth Report of the san station, p. 80, 1892, he refers the fungus back to *C. phomoide* Sacc. Our species is the same as the one considered by Profess Chester, as we sent specimens to him for comparison. He h kindly loaned us the fine cuts which are used to illustrate this articl

Professor Chester is of the opinion that the characters used b botanists to separate the genera *Colletotrichum and Glœsporiu* viz.: the presence or absence of setæ in the fruiting tufts, evanescent. If this should be established the genus *Colletotrichu* would be merged into *Glœosporium*. The investigations of Mi Southworth, Professor Halsted and Professor Chester indicate th several forms of *Glœsporium* separated as species on account living on different host plants will have to be merged, or that the is a species of *Glœsporium one and t same*, capable of a wide range of par sitism and of producing *Anthracnose* a variety of hosts. It looks as thoug careful laboratory methods would mak havoc with the present nomenclature fungi, by merging stages of the life histo of forms and uniting species that have bee separated on the principle, that each ho harbors its peculiar parasites. The abo is only of importance to mycologists. The characters and tre ment are of more interest to the grower of tomatoes.

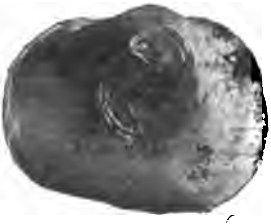
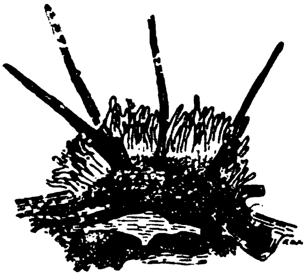


FIG. 2. Tomato. Affected by Anthracnose. Colletotrichum phomoides, Sacc.

CHARACTERS.



* Fig. 3. A fruiting tuft of Colletotrichum phomoides, Sacc. Tomato-Anthracnose.

This disease makes its appearance upon ripening or fully ripe tomatoes upon the vines or develops rapidly upon gathered fruit. It appears on the tomatoes as rounded, sunken, discolored, wrinkled spots with a black centre. See Fig. 2. Contiguous spots become confluent forming diseased areas. An examination of these dark parts in the diseased areas, discloses numerous microscopic, oblong bodies, the *spores* of the fungus. See Fig. 4. These spores reproduce the disease. Prof. Chester found that these spores inserted under the skin of healthy tomatoes would rapidly cause the disease. Not being able to develop the disease by putting the spores on the unbroken skin of the green and ripe tomatoes would indicate that the disease is an internal parasite and can not be reached by spraying with Potassium Sulphide as is recommended by Mr. Bragg of the Oregon Station in a recent bulletin.

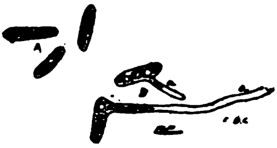


FIG. 4. A. Mature spore. B. Germinating spore of Colletotrichum phomoides, Sacc.

This disease opens the way for the attack of other species of fungi that hasten the decay.

Fig. 3. shows a cross section of one of the diseased spots highly magnified.

REMEDIES.

1. Spray the vines and young fruit with Potassium Sulphide (Liver of Sulphur)—formula.—Dissolve seven ounces of Potassium Sulphide in twenty-two gallons of water and apply with a spraying apparatus. As stated above this may not be useful for this disease but is regarded a remedy for external tomato fungi.
2. Gather all diseased vines and tomatoes and burn them.
3. Change the location of the tomato patch if the crop has been affected.
4. Do not take seed for planting from diseased tomatoes.

POTATO AND BEET SCAB.

Oospora scabies, Thaxter.

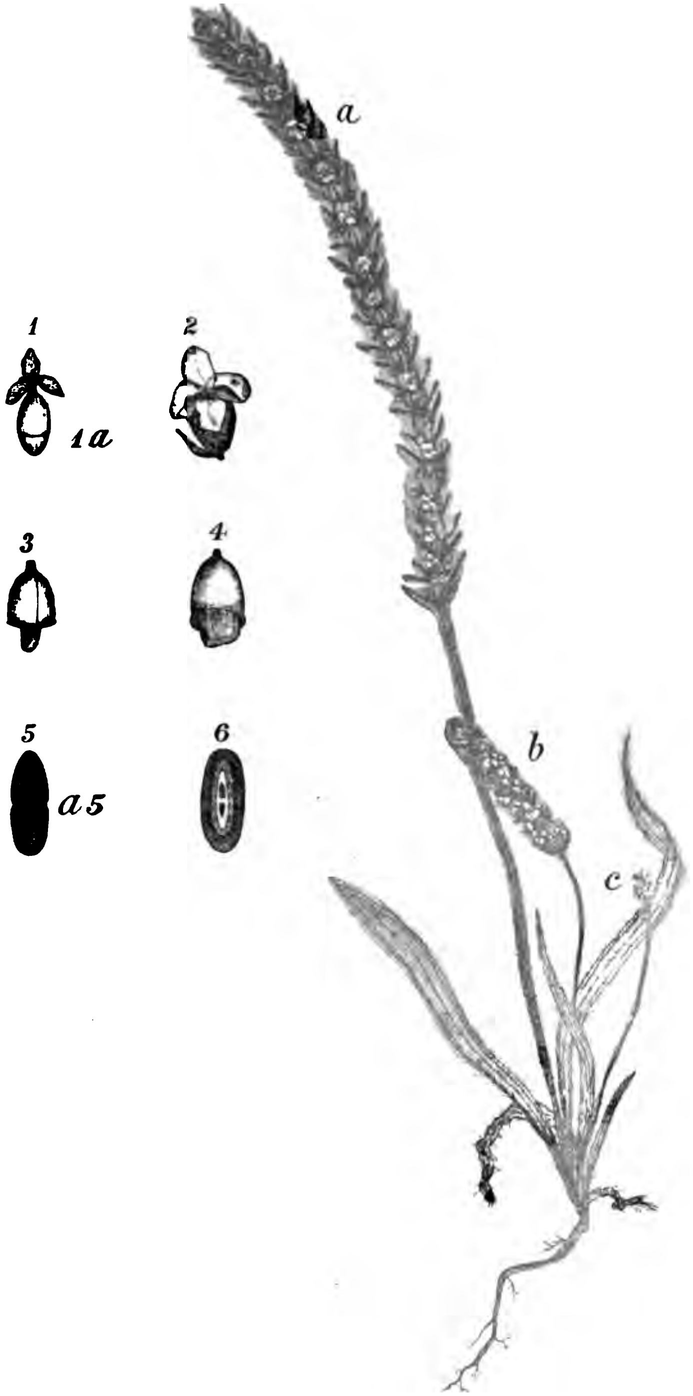
The scab of potatoes and beets has been quite prevalent the pa season. The ordinary disease of potatoes and beets known "scab" has been demonstrated by Dr. Thaxter to be due to t same fungus, the species named above. Now that the cause known experiments for checking the disease can be conducted up a rational basis. Professor Bolley exhibited at the World's Fa Chicago, in the exhibit of the office of experiment stations, t jars of potatoes grown under similar conditions from scabby see One lot was treated with a dilute solution of corrosive sublima and the other lot was untreated. The former lot was comparative free from scab and well grown. The latter badly scabbed a dwarfed.

This would indicate that scabby seed may be the cause of t disease and that clean seed should be planted. It would also f low that scabby seed *treated* will produce much better potatoes th scabby seed *untreated*.

We feel positive that the disease cannot be controlled merely planting clean seed. The last season we planted clean seed up soil that had not grown potatoes for two years and raised a ba scabbed crop. It seems certain that this disease may live in t organic matter of the soil even more than one year or else has ot hosts which have not been discovered upon which it maintains itse

Will treating clean seed with corrosive sublimate give a bet crop than clean seed untreated? If not we see no great use for for clean seed is usually obtainable.

Experiments to show the vitality of this fungus in soil not gro ing potatoes are desirable in order to learn whether a system rotation may not clean the soil of the disease. Experiments sho be conducted with clean seed upon grass lands in order to le whether they are free from the fungus and settle the quest whether newly turned grass land is better for potatoes. The stu of fertilizers in relation to the introduction of this disease is portant. Considerable more study upon the conditions of gro of this fungus is necessary.



WESTERN PLANTAIN.

Plantago Patigonica, var. aristata, Gray.

Figs. a, b and c show spikes in different stages of growth. Fig. 1. Back view of flower with calyx removed Fig. 2, front views with calyx and basal bract. Figs. 3 and 4, portions of capsules. Figs. 5 and 6, dorsal and ventral views of the seed.

WESTERN PLANTAIN.

Plantago Patigonica, var. aristata, Gray.

Specimens of the above plant were received the past season fro Mrs A. M Pikes, East Madison, Somerset county, and fou growing in an oat field. This plant belongs to the *Order Plant* *ginaeæ* and is a near relative of the ENGLISH PLANTAIN considered Experiment Station Report, 1890, p. 119. It was probably intr duced with the seed. A few specimens were found growing on t college campus a year or two ago, introduced with grass seed, b they were not allowed to drop their seed. This plant is wide distributed in South and North America and in the West is a b weed It presents a number of varieties besides the one nam above. As it has become established on Martha's Vineyard a about Boston it would no doubt find a congenial home in Southe Maine, and this is written to call attention to it.

It can never become so bad a weed as its relative, the Engli Plantain, which has a strong foothold in some parts of Maine as is an *annual* and could be eradicated in a single season if prevent from seeding. It may be known by the following description:

About a foot high, having usually several slender, naked, flowe ing stalks. which start from a cluster of leaves near the ground a bear on their top a close spike of flowers. The leaves are narro from three to five inches long, and bear a few nearly promine parallel ribs. The variety under consideration is clothed with sil hairs and below each flower in the spike is a bract two or thr times the length of the flower. The seed are boat-shaped as in t English Plantain. The seeds germinate the same season they rip and the young plants mature the next season. It seeds profuse and a few plants would give it a good start. That the plant m be readily detected we reproduce from the United States Agricu tural Report, 1888, plate XI, a cut of this weed, which is sho on the opposite page.

ENTOMOLOGY.

The Angoumois Grain Moth.

(*Gelechia cerealella*, Linn.)

Order Lepidoptera: Family Tineidæ.

The above insect was detected the past season as detailed below. Experiments made by Mr. F. M. Webster show that the New England climate will not destroy this pest but only check its depredations during cold weather. His experiments also show that the pest can be destroyed by a temperature of 130° Fah. kept up for four or five hours. The accompanying cuts show the life history of this moth, and the nature of its work. Below we give an article upon this insect contributed to the *Maine Farmer* by the writer.

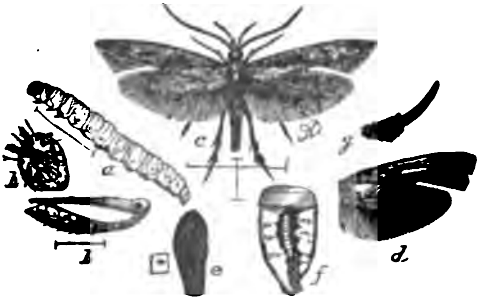


FIG. 5. Stages in the life history of the Angoumois Grain-moth, Gelechia cerealella, L.

Editor Maine Farmer: My attention was called a few days ago to the above insect found in great numbers in boxed Shaker rice pop corn, put up by R. H. Wright, Albany, N. Y., and obtained for retail in Orono from a wholesale house in Bangor. As this is one of the most destructive insects known to wheat, oats, barley and Indian corn, it seems desirable that attention be called to it. Upon opening the boxes swarms of full fledged moths were found on the top of the corn, and made their escape into the room. The kernels of corn each contained small circular holes, and the most of the starchy matter was eaten, leaving only the shell. Mixed with the corn were a large number of dead moths. The party who found the moths let the live ones from several boxes of corn escape in the store, and when I told him it was a bad pest, he said they would all die, as the store was cold nights, and that he had burned all the corn. Though this insect was introduced from France, and has done more damage South than North, yet it is undaunted by a cold climate, and would be capable of doing much damage in stored grain in Maine. This insect was abundant in the grain exhibits at the World's Fair the past season. To burn the corn after the moths had all escaped was useless. That this insect may be better known, so that precautions can be taken against it, we give the following regarding its life history:

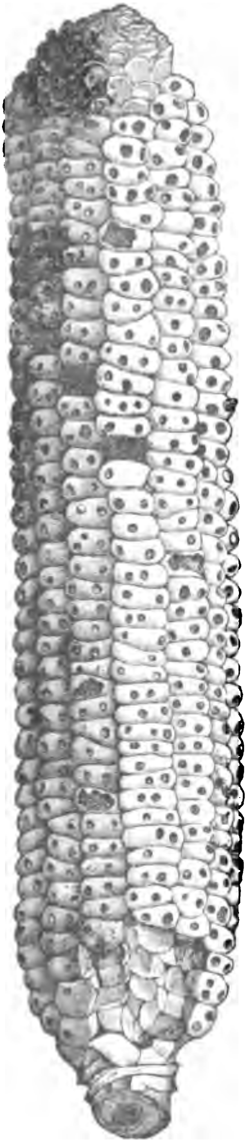


FIG. 6. Work of the Angoumois Grain-moth, Gelechia cerealella, L.

Perfect insect, a small moth with pointed wings, that spread between a half and three-quarters of an inch. Fore-wing pale shining ochre, with a grayish or brownish gray streak in the folds at the base, and a few scales of the same color toward the tip of the wing on the margin. Hind wings grayish ochre, and bearing a fringe of the same color on the border. *Larva*, a smooth, white worm, attacking the kernels, and consuming the inside, leaving the shell, and when full fed transforming to the *pupa* state in the grain, and finally emerging as a moth through a small hole in the kernel.

REMEDIES.

Bisulphide of carbon is now quite largely used to destroy insects infesting stored grains.• In France they put the grain into an *insect* mill something like a peanut or coffee roaster, and raise the temperature of the grain high enough to kill the moths, eggs and larvæ. When the quantity of grain is small, it might be thrown into *hot water* or *heated*, and then fed to fowls. The work of this insect resembles in its effects that of the pea weevil, only the hole made by the moth is smaller, and so far as we know these insects never encroach upon each other's domain, the moth infesting the seeds of graminaceous plants, while the pea weevil is partial to legumes. Whether this corn was infested before it left the *Shakers*, or whether it lay in the wholesale houses in Bangor during the past summer, and was infested by moths of home production we do not know, but the moth is here *sure pop*, and we will have to look after it.

F. L. HARVEY.

ORONO, December 11th.

THE LIME-TREE WINTER-MOTH.

Hybernia Tillaria, Harris.

Order Lepidoptera: Family Geometridae.

Among some specimens of female Canker-worms received from Mr. F. W. Hilt of Warren, Maine, were several wingless females of the above species. The specimens were found on the side of a house where they had probably crawled to lay their eggs or meet the males. As the Canker-worm is very bad in Maine and as this insect has similar habits they should be distinguished.

DESCRIPTION.

Eggs pale yellow, oval and marked with a net work of raised lines. They can be distinguished from the eggs of the Canker-worm by their color and form. (See Experiment Station Report, 1888, p. 167, Fig. 20.) The eggs are laid in similar situations as those of the Canker-worm. As the females of both species had commenced to lay eggs in the box in which they were sent we cluded they were probably crawling up the side of the hous deposit the eggs.

Larva, when full grown, about an inch and a quarter long. H dull red with a V-shaped mark on the front, yellow above marked with many longitudinal black lines; the under side p Like the larva of the Canker-worm it is a *span* or *inch* worm larger than the caterpillar of that species. The accompanying (Fig. 7) shows the larvae feeding and at rest.

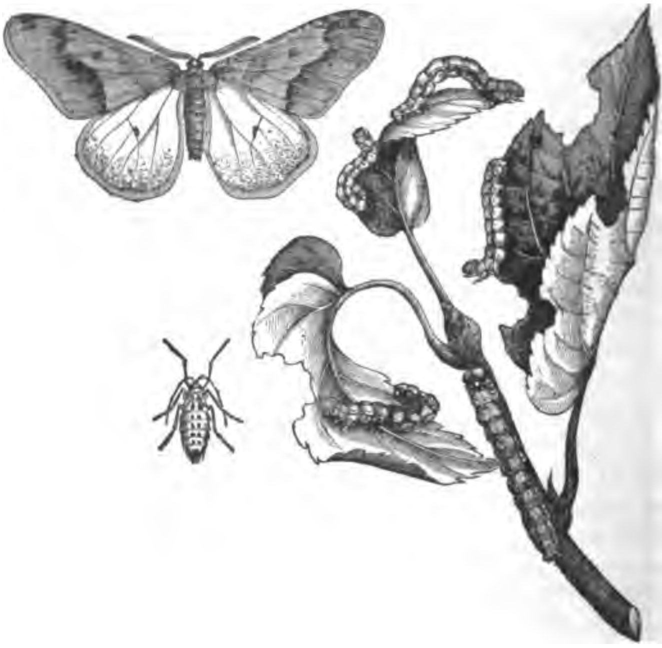


FIG. 7. The Lime-tree Winter-moth, Hybernia tiliaria, Harris. Male, wing female and larvae.

Female Moth, wingless, spider-like, yellowish white, sides mar with black dots, each ring of the body, excepting the last, be two black dots, which has only one. Head black in front and legs ringed with black. Antennae thread like. Ovipositor join and retractile. The larger size, the spotted back and black ri on the legs readily distinguish this from the wingless females the fall and spring Canker-worms. Fig. 7 shows the wingl female about natural size.

Male Moth, expanse of fore wings an inch and a half. Color, rusty buff sprinkled with brownish dots and with two transverse brown wavy lines, the inner most distinct. Between the bands and near the anterior edge is usually a brownish dot. Hind wings paler. Body color of fore wings The antennæ are feathered. Like most of the moths of the inch worms the wings are very delicate. The male moth about natural size is shown in Fig. 7. The moths of the Canker-worm would be on the wing at the same time but they are smaller.

LIFE HISTORY.

The eggs hatch early in the spring and the young larvae feed upon the foliage of the apple tree, basswood, elm, hickory, etc., and are full grown about the middle of June, when they usually let themselves down by a silken thread, enter the ground about five or six inches, form a little oblong cell within which they change to the chrysalis state. In October or November (sometimes not until the following spring) when the moths appear. The wingless females climb the trees or other objects where they meet the winged males, pair and soon deposit the eggs in clusters, (usually upon the branches of the tree they have infested,) completing the life history.

REMEDIES.

The life history of this species is so nearly like that of the Canker-worm that the remedies suggested for that insect are applicable to this. It has never done as much damage as the Canker-worm but it is capable of doing much injury to the foliage of apple trees and from the specimens received we should judge that it is quite abundant about Warren, Maine.

THE APPLE-LEAE BUCCULATRIX.

Bucculatrix Pomifoliella Clemmens.

Order Lepidoptera: Family Tineidæ.

We received from Mr. D. P Boynton, Monmouth, Me., a lot of apple tree leaves badly eaten by the larvæ of the above moth. In the box were quite a number of the larvæ and cocoons. This is the first time we have seen this species in Maine and as it is capable of doing considerable damage to the foliage of apple trees, we give the following account of it, so that it may be known and measures adopted to prevent it spreading.

HISTORY.

This moth was described by Clemens in 1860. It is known to be widely distributed having been reported from Texas, Missouri, Massachusetts, New York and now from Maine. It has done considerable damage to the foliage of apple trees especially in New York.

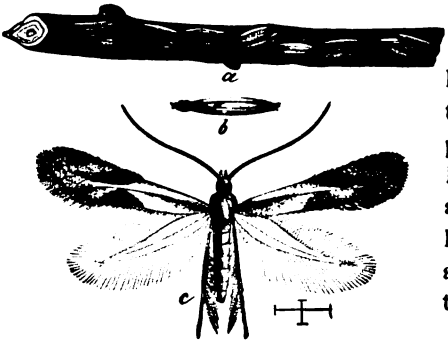


FIG. 8. The Apple-Leaf Bucculatrix. Bucculatrix pomifoliella, Clemmens. Moth enlarged, cocoons natural size and enlarged.

DESCRIPTION.

Eggs—So far as we know the eggs of this species have never been described. They must be quite small as the cocoons of this diminutive moth have been mistaken for insect eggs. They are said to be laid upon the leaves. We have never seen them.

Larva—About one-half inch long when mature, cylindrical, tapering at both ends. Joints of the body rounded and prominent, color dark yellowish with a greenish tinge, and reddish shades on the anterior segments. Body armed with short black hairs which are more numerous on the back of the first segment. Head small, brown and elipsoidal. The larvæ are active and when disturbed suspend themselves by a silken thread.

Cocoons—Dirty white, slender, about one-fourth inch long, ribbed longitudinally by about six prominent ridges, oblong, tapering and thinning at both ends, flattened on the side to which it is attached. Usually fastened to the twigs and branches in groups as shown in Fig. 8 a. Fig 8 b shows one of the cocoons enlarged. The specimens we had were confined in a box and the cocoons were attached to the leaves and side of the box. If it can be shown that in nature the cocoons are never attached to the leaves it would indicate a remarkable instinct, for if attached to the leaves which fall they would probably be destroyed, while attached to the twigs they would be safe during the winter. The cocoons contain the

Chrysalis which is dark brown, rough, punctured on the back, twelve hundredths of an inch long. When ready to transform the chrysalis works itself partly out of the cocoon and the moth comes forth.

Perfect insect a small moth that is only about one-fourth inch expanse of wings. Fore wings whitish tinged with pale yellow and dusty brown. On the middle of the inner margin is a conspicuous oval brown spot. A wide streak of the same color on the opposite margin which extends nearly to the end of the wing where it tapers and points to a small circular brown spot near the tip. The moth much enlarged is shown in Fig 8 c. The hair lines to the right show the natural size.

LIFE HISTORY.

This insect spends the winter in the chrysalis state in the cocoons usually attached to the twigs and branches of the host plant. There is reason to believe that the larvæ when full grown sometimes desert the host plant and form their cocoons on other plants close by. About the time the leaves unfold the moths come forth and lay their eggs upon the tender foliage. The larvæ are full grown in July. The specimens sent us in July were in the larval form and went into the chrysalis state in August and have not yet (January) emerged, which would indicate only one brood in Maine. Prof. Riley thinks there are two or three broods in the latitude of St. Louis. Mo. In the latitude of New York, Prof. Lentner states that there are two broods, one in July and one in September. Our specimens would belong to the July brood and possibly may be diseased and may not emerge. Possibly we have two broods in Maine. In September or October the cocoons are formed in which the pupæ spend the winter. The larvæ feed externally upon the foliage, at least the leaves we received had the upper epidermis and pulp eaten away in patches, the veins and lower epidermis intact.

REMEDIES.

Natural—This small moth is preyed upon by several paras that attack the larvæ and hold the pest in check. Some of cocoons probably suffer somewhat from inclemency of the weatl Possibly birds may eat them but we find no record of observatio

Artificial—(a) Jar the trees when the larvæ are full grown they will suspend themselves by threads and can be swept d by a broom and killed by hot water or crushed.

(b) Apply kerosene emulsion with a spraying pump to branches in winter that bear the cocoons. The same applica might be made for the first brood when the foliage is on. Str soap suds alone probably would kill them.

(c) If in small numbers the cocoons can be removed du the winter months by the hand.

THE DISIPPUS BUTTERFLY.

Limenitis disippus, Godt.

Order Lepidoptera.

We receive the larvæ of the above species occasionally account of the fact, that the second brood of larvæ hybernate w about half grown and make a beautiful hybernaculum that is s to attract attention, also the larvæ is highly ornamented w colors and tubercles, and quite noticeable. The eggs are bea fully reticulated, small and laid on the under side of the leaf n the end. Most people are surprised to learn that those grotes larvæ and odd hybernacula pertain to one of our common but

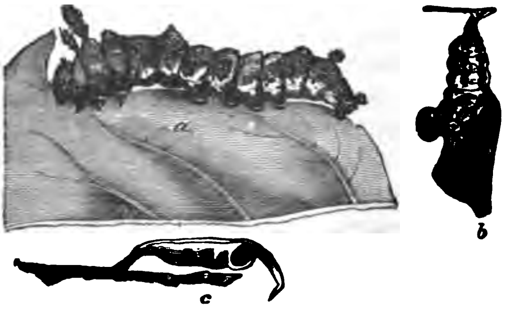


FIG. 9.

flies. Fig. 9 a shows the form of the full grown larvæ, b, the chr alis, c, the hybernaculum in which the half grown larvæ of the brood spends the winter. Fig. 10 shows the orange-red butterfly full size. The wings bear heavy black veins and a black border spotted with white.

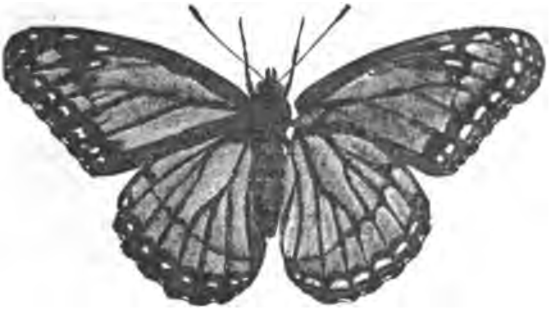


FIG. 10.

LIFE HISTORY.

The hybernating larvæ complete their growth go into the chrysalis state and the butterflies are on the wing by July. These deposit their eggs sometimes on the leaves of plums but usually upon willow or poplar. The eggs soon hatch and in a month the larvæ are full grown, enter the chrysalis state and in a short time the second brood of butterflies appear. These lay eggs which soon hatch and when the larvæ are less than half grown they make hybernacula from the leaves in which they spend the winter.

THE MAY BEETLE.

Lachnosterna fusca, (Frohl.)

Order Coleoptera: Family Scarabæidæ.

We received the following letter last September in reference to the above insert:

"BRIDGTON, Maine, September 18, 1893.

Professor Harvey:

DEAR SIR—I send you specimens of a worm that is doing a great amount of damage to the farms in this vicinity. There are many acres of grass land in this town where a good crop of Timothy was cut the present season which now show hardly a green blade of grass. These worms are found just below the surface

where they feed upon the roots of Timothy. Can you tell us t
name of the worm, its habits and if there is any way of extermi
tion or curtailing its ravages? Will you please answer at once
we wish to find out how to treat the land this autumn.

"An early reply will greatly interest many farmers in this s
tion of the State. Respectfully, J. L. Wales."

In response we sent Mr. Wales what information we had rega
ing the methods of coping with this pest. Mr. Wales publishe
newspaper article on this insect from which we make extracts
show the extent of the ravages of this insect in the State.

WHAT SHALL BE DONE WITH THE "WHITE GRUB."

This is becoming a very serious question with many farmers a
gardeners at the present day in the town of Bridgton and vicini

A few days since Mr. A. M. Thomes, the owner of a nice fa
on High street invited me to visit his grass fields. In one corn
of a fine, large field which had borne a heavy crop of Timothy t
present season, we found rather more than a half-acre upon whi
there was not visible a sign of vegetable life. What had compos
the turf or sward could be stripped off and rolled up like a carp
leaving the soil naked and brown and bringing to light upon ea
square foot of surface from a dozen to twenty flat white grub
Several of these were put in alcohol and sent to Prof. F. L. Harv
of the State Agricultural College at Orono, who kindly a
promptly sent what information he had at hand relative to t
name, habits, and remedies, for this pest of the farmer. The gru
especially loves to feed upon the roots of Timothy or herds gras
as may be seen upon the farms of Mr. Thomes, M. B. Ston
Nathan Palmer, Geo. Hilton and many others; it also loves t
roots of the strawberry. Mr S. E. Lee of High street lost abo
one thousand fine strawberry plants the present season. The roo
of corn are often devoured by the grub as may be seen on the far
of Mr. Geo. Chaplin, Naples Mr. John Palmer of South Bridgt
lost a part of his potato crop in the same way.

Complaints from other parties and from other sections of t
State show that the "White Grub" is wide spread and doing muc
damage in the State.

This insect is so familiar to everybody that we will take spac
to give an account of its life history but publish herewith a c

so as to show clearly what insect is meant. Figure 11. 1 shows the pupa, 2 the grub, 3 and 4 side and dorsal views of the beetle. This insect is known as the "May Beetle," "June Bug" and "White Grub." In the larvæ state it feeds upon the roots of plants having done much damage to grass lands and especially to strawberry vines The beetle feeds upon the foliage of trees and where abundant often entirely stripping them of their leaves. The beetle is attracted by lights and is a frequent evening visitor to our living rooms while on the wing. The impression prevails that the eggs are laid on grass near the roots though perhaps this matter may bear further study.

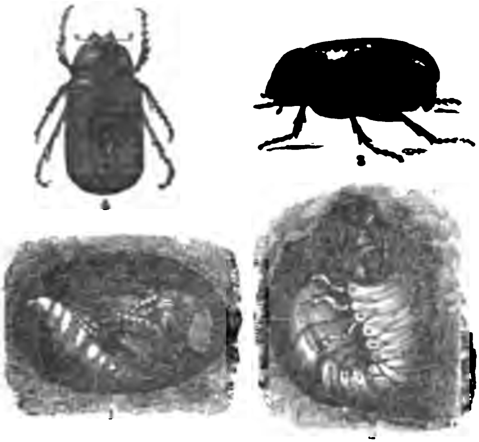


FIG. 11. The May Beetle. Lachnosterna fusca, (Frohl.) 1 pupa, 2 larvæ, 3 and 4 Beetle.

REMEDIES.

The Department of Agriculture at Washington, D. C., has conducted some experiments to show that kerosene emulsion liberally applied to the soil infested with "white grubs" will destroy them. The remedy would be too troublesome and expensive for application in large meadows but for small areas is worthy of trial. We extract the following from Prof Riley's letter regarding the subject: "The application of kerosene emulsion for white grubs is impracticable over very large areas owing to the necessity of washing the emulsion into the soil to considerable depth by a copious application of water, unless the application can be made with tolerable certainty of its being followed by slow and continuous rains such as will carry it into the soil gradually without washing it away. These conditions will not often be available at the time wanted, but for all limited applications as to lawns or limited patches of ground affected by the larvæ, there is no better remedy than the kerosene emulsion treatment. I have no accurate data as to the amount required per acre but if the emulsion is applied sufficiently to thoroughly wet the surface of the soil to the depth of an inch or

more and then carried down by applications of water to a depth
about eight inches during the next two or three days, the treatm
will certainly prove effective. The amount necessary will vary w
the different soils. both of the emulsion and the water applied la
on to carry it down, easily permeable, sandy soils requiring l
than denser clay soils.

Professor J. B. Smith has found potash fertilizers in the form
Kainit, applied as a top dressing efficacious against root affecti
insects, such as wire worms. We wrote Professor Smith rega
ing the matter and below is his reply.

NEW BRUNSWICK, N. J., September 22, 1893

DEAR SIR—Your card of the 20th inst., is at hand. The lat
on Lachnosterna you will find in Forbes' 17th Illustrated Repo
issued in 1891. I have had no personal experience with th
insects from the economic side, and cannot give you any posit
or tried suggestions. You know my hobby, and if the matter ca
to me in New Jersey, I would advise heavy top dressings of Kai
and Nitrate of Soda applied in combination after the flight of
beetles is over in spring, or the former alone applied early in S
tember. Yours very truly, JOHN B. SMITH

Professor F. L. HARVEY, Orono, Maine.

Mr. Wales in his article suggests the following: "In the days
our fathers when the 'burnt pieces' were lighted up at night ti
by the partially extinguished fires, the farms and orchards we
not infested by so many hostile enemies; and would not fi
kindled in the neighborhood of orchards for a few evenings in la
May or early June destroy the beetles and thus prevent the pr
duction of the white grub?"

The rooting propensities of swine can be put to practical accou
in destroying this pest. If I had meadow land on which the s
was dead and could be rolled up like a carpet, I would construct
movable fence and enclose the small areas and turn in a few hog
The land would have to be reseeded and the swine could do
damage, and they would probably devour a large number of
grubs

Skunks and crows are known to be enemies of the "white grub
but owing to the demand by furriers for the pelts of the form
and our anti-crows law against the latter we have not much to ho
for in those directions.

We hope the farmers whose fields are infested will try some of these measures. There is one consolation and that is the life history of this pest is completed in three years and it would not probably lay its eggs on the same ground again, but seek some new field of conquest.

The Bean Weevil.

Bruchus obtectus, *Say*.

Order Coleoptera: Family Bruchidæ.

We received specimens of beans infested by the above insect from Hon. Samuel Libby, Orono. He gives the following interesting history regarding them: "The beans are of the horticultural variety and were gathered in the pods when ripe in September, 1891, and taken to my store where they lay until October, 1891. I then sorted out those that had six beans in a pod for seed and also those with five beans in a pod for second choice. The lot having five beans in a pod were put in an open basket in the store. They remained there during the summer of 1892 and about January 1, 1893 I had occasion to examine them and found they were infested. About one-tenth of the pods had holes in them and I found fine dust falling from the beans, and saw the holes in them. I also noticed small black objects in the basket. Not knowing that there was a bean weevil that worked on beans as the pea weevil does on peas I laid them aside for you.

The pods having six beans in them were shelled and planted in the spring of 1892 and showed no signs of weevil work. I have grown horticultural beans for twenty years and have always raised my own seed. In 1891, 4, planted beans obtained elsewhere and the beetle might have been introduced with that seed. "The crop of 1892 shows no evidence of weevil work."

We examined the specimens submitted and found them to be *Bruchus obtectus*, Say. The beans contained eggs; minute larvæ just hatched; larvæ one-third, one-half and full grown; pupæ in various stages of development; full grown pale colored beetles; some full colored ready to emerge; others free in the basket alive and some apparently dead. There were as many as twenty individuals in some of the beans. There were numerous holes in some of the beans from which the beetles had escaped, also many oval translucent places where the coating of the bean had been ma thin by the beetles indicating their location within. The insi of some of the beans was completely eaten and only the powde excreta remaining. We wish to add our testimony to that Popenœ, Schwartz and Lintner that successive generations of th insect occur in stored beans, and also that if the food supply do not become exhausted they may survive into the *second seaso* They will eat cotyledons, radicle and plumule. Several specime showed the cotyledons entirely detach from the radicle and intact. We believe the radicle is rejected not because it is le desirable for food but on account of it being small and near isolated from the bean mass. We found one specimen with t cotyledons nearly intact and the radicle eaten, its place bei occupied by a well fed larva. In some specimens *nothing* remaine excepting the seed coats filled with powdery excreta.

It has not been clearly shown that the beetles will not fly crawl to new lots of stored beans and infest them.

Or in other words it is not known whether beans may beco infested after they are stored by the beetles laying their eggs up them. The general belief is that the beetles confine their attac to the lot of beans infested and that they spread during the summ through the agency of eggs laid on the growing pods.

Prof. Lintner has shown that the beetles will lay their eggs up dry beans and that in the infested lot that the young larvæ wi gnaw into them and perfect themselves.

The fact that a part of the lot of beans which Mr. Libby took his store was not infested when shelled the next spring would le one to suspect that the others may have been infested by beetl getting into them after they were stored. The holes in the po may have been made for the entrance of beetles as well as for the exit. The holes being in the pods shows that the beetles as we as the larvæ have adequate gnawing powers. The only thing th would prevent infection this way would be the sluggish habits the beetles. Those we had in a warm room in January were qui active. They did not fly but crawled rapidly. Prof. Lintner observations show clearly that they may spread from the bea originally infested in a lot to the others stored with them. It also important to know whether the beetles that mature at all se sons of the year may not fly to new lots of stored beans and infe them.

The fact that successive generations occur in stored beans; that sound beans in the same lot may become infested and that possibly new lots may also become infested, makes this weevil a more formidable pest than was formerly supposed.

Beans are largely grown and consumed in Maine and should this insect become common much damage might be done. Below we give its history, characters and remedies.

HISTORY.

This species is probably not native but was introduced as early as 1860, at least, possibly from *Asia*. It would seem that it has erroneously been considered the same as *B. obsoletus*, Say., bred from *Astragalus* seeds from Indiana as early as 1831. This view is strengthened by the fact that it was found in 1876 at Philadelphia in beans from various countries from both continents. At present it is cosmopolitan. It was first noticed in Rhode Island in 1860 by Dr. Fitch, who described it as *Bruchus Fabœ*. Within the next ten years it was carried to nearly all parts of the United States. In 1870 it was known from several of the New England States. So far as we know it has not previously been reported from Maine. Professor Fletcher has not found it in Canada. As the beetles are sluggish and disinclined to fly it is mainly distributed in infested beans. Those wishing a fuller consideration of this insect will find an interesting summary of the facts known regarding it in Professor Lintner's 7th Report of the Injurious and Other Insects of the State of New York, p. 255.

Characters—A small beetle that would be usually found infesting beans or associated with them. See Fig. 12. There are two closely related species of *Bruchus* that have been found infesting beans in this country. The above species is by far the most

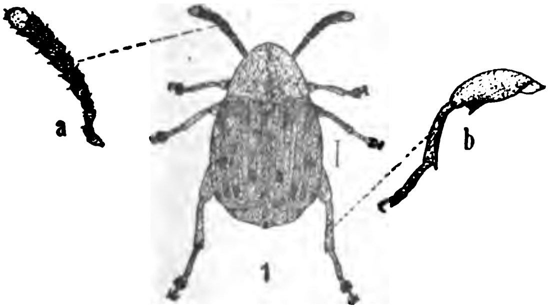


FIG. 12. Bean Weevil, much magnified.

common. It is one-tenth of an inch long, oval in form, head be
downward and more or less concealed from above, prolonged ir
a short, squarely-cut beak. Antennæ distinctly jointed, enlarg
at the tip, the four basal and the terminal joints reddish or yello
ish. Thorax and abdomen about the same width where they jo
Wing covers marked by ten impressed and punctured lines in fl
tened ribs, which are clothed with a short pubescence, arranged
yellowish, black and whitish spots and lines—the white lines mo
distinct on the third rib. The abdomen is pale, dull yellow, with
black band on the fore part of each joint. It projects beyond t
wing covers and that part is obscure grayish with a faint, mediu
whitish stripe. The hind thighs near their end armed with a lo
and two short spines. Feet reddish.

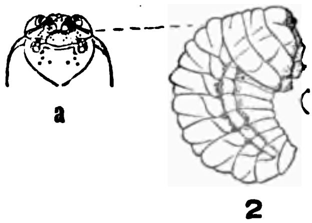


Fig. 13.

The larvæ are white a
broadly oval, see Fig. 13. T
eggs white, thicker at one e
and about three times as lo
as wide.

The work of this insect a
pear on the surface of the bea
as small holes from which t
beetles have escaped, and sm
oval, translucent spots on t
surface over the cells that co
tain bettles that have n
emerged. The work is show
in Fig. 14. The inside of t
bean in badly infested spec
mens is entirely converted in
a powdery mass of excret
Often the beans will conta
larvæ in various stages
growth and also beetles. Fi
15 shows the pupa. Fig. 1
shows the closely related Pe
Weevil, enlarged and natur
size, which is given for comparison.

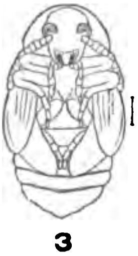


Fig. 15. Bean Weevil pupa.

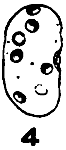


Fig 14. Bean Weevil. Work of the insect.

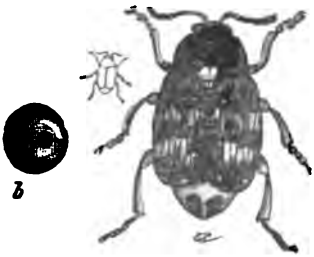


FIG. 16. Pea Weevil. a, natural size and enlarged; b, work of the insect.

LIFE HISTORY.

The eggs are laid upon the young bean pods after the flowers have withered, at any point, and sometimes many on a pod. The eggs hatch in a few days and the young larvæ enters the growing bean. It lives upon the substance of the bean making an excavation somewhat larger than itself in which it transforms to the pupa, finally to the beetle state. The beetles may emerge in the fall or at any time during the winter, lay eggs, which hatch and the larvæ enter the same beans or new ones. Successive generations may occur until the food supply is exhausted. Those beetles on the wing during the summer lay their eggs in the pods of the growing crop. The length of time required for the transformations has not been studied but probably is variable with circumstances. We found quite a number of dead beetles within the cells in the beans.

PRECAUTIONS

Experiments have shown that beans infested with *weevils* will not all sprout and that the plants from them are sickly and do not produce a full crop. It is therefore best not to plant them. It is believed upon good authority that beans containing the weevils in the beetle form are probably injurious and unfit food for man or beast.

REMEDIES.

If beans are found to be badly infested so as to be useless for food or seed, they should be *burned at once* so as to prevent the escape of the beetles.

Beans should be kept in a tight box or bag and any beetles that escape in the bag destroyed.

Throw the infested beans into hot water. (The exact amount of heat that beans will stand and germinate is not known but experiments would determine.) We feel sure the germ will stand more heat than the weevils.

Prof. Weed killed pea weevils by exposing the peas to a temperature of 145° F. for an hour. Bean weevils probably could be destroyed in the same way.

Probably the best way is to put the beans into a tight box a fill it with the vapor of *Bisulphide* of *Carbon* and leave it for t or three days. Bisulphide of Carbon is *very inflamable* and light should be brought near it.

Experiments show that infested beans lack in vitality and wh good seed can be had it is best to procure it and not run the r of perpetuating the pest and growing a crop of weakened plants.

The Pear-Blight Beetle, or Shot-Borer.

Xyleborus pyri, Peck=X. dispar, Fbr.

Order Coleoptera: Family Scolytidæ.

Last summer we received some small apple tree limbs fro Professor Munson for examination. They were handed to him Mr. J. N. Allen, North Sedgwick, Me. We obtained the san insect from Dr. Twitchell about the same time from the vicinity Augusta. These limbs were literally honey-combed with sma channels that extended through the liburnum and heart wood to th centre. The exit holes through the bark were .06 to .08 of a inch in diameter and nearly circular, looking like small shot hole The wood was green showing that the insect attacks the growin tree. Living wood does not appear to be essential to the life an comfort of this species, for after a period of several weeks w found in a limb that had been in a dry place in a box, youn larvæ, full grown larvæ, pupæ and perfect beetles. We put a po tion of a small limb (2 inches by 3 inches) in a box and allowe the pupæ to transform and in the fall we found fifty beetles ha emerged.

We wrote a short account of this insect at the time for th *Maine Farmer* and called it *Xyleborus pyri*, Peck, the Pear-bligh Beetle. To be absolutely certain we sent some specimens to Mr A. H. Hopkins, Morgantown, West Virginia, who has given specia attention to the *Scolytids* and he sent the following reply:

"The beetle you sent is *Xyleborus pyri*, Peck=*X. dispar*, Fbr This species is quite common in West Virginia, but strange to say I have never met with it in apple or pear trees. I find it in hem lock, beech, birch and oak. I have specimens of X. dispar from

Germany and though I can detect a slight difference between the females of the European and American form yet there is not difference enough to separate them as distinct species." We have seen this beetle in abundance in juniper about Orono and we have no doubt that it has transferred its depredations from adjacent forest to the orchards. Professor Fletcher reports its increase in Nova Scotia.

Below we give a description, the life history and suggestions for the treatment of this beetle.

DESCRIPTION.

So far as we know the eggs have not been described. They must be very small and are said to be laid at the base of the buds. We have never seen them. The young larvæ bore into the wood making deep channels which in small twigs interfere with the circulation of the sap, and the twigs wither giving the appearance of blight, hence the name Pear-blight Beetle. The work of this beetle should not be confounded with the Pear-blight proper which is caused by a species of bactaria. When the larvæ are full grown they transform to pupæ in the burrows and finally emerge as small beetles about one-tenth of an inch long and of a dark brown or nearly black color, with the antennæ and legs of a rusty red. The thorax is short, very convex, rounded and roughened. The wing covers are marked by longitudinal rows of punctures. The hind part of the body slopes abruptly. The beetle natural size and enlarged are shown in Fig. 17. The beetles leave their burrows in July and deposit eggs before August.

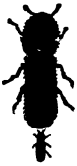


FIG. 17. Pear-blight beetle. Natural size and enlarged.

REMEDIES.

As these beetles work wholly under the bark they cannot be reached by insecticides. The only way is to watch the trees during the latter part of June and July and if blighted twigs or diseased limbs are noticed examine the branches for small pin holes and if found the presence of this or some related species may be suspected. The diseased limb should be cut *at once* below the injury far enough to include all the burrows, and *burned*, for the beetles will transform, emerge and attack new trees. As these beetles live in forest trees orchards near timber would be more likely to become infested.

Carrot Fly—Carrot Rust Fly.

Psila rosæ, Fab.

Order Diptera:

We received the following letter from Mr. Morrell which w accompanied by the *larvæ* and pupæ of a species of fly, also pie of carrot in which the maggots had been working.

“Pittsfield, Maine, April 6, 1893

Professor F. L. Harvey:

Dear Sir—I send little worms which I would like to have y identify. The worms are in our carrots and have made holes through them. after the manner of those in the piece I se The carrots were placed in a barrel and the barrel filled up w fine dry sand like that I send. On sifting the sand I find it full worms. Beets grown side by side with the carrots, and packed the same kind of sand have no worms. Very truly,

C. H. Morrell ’

Not recognizing the species we wrote Mr. Morrell that the spe mens were the larval and pupal stages of a fly that we would ha to transform and obtain the flies before identifying it. The infest material being only a barrel of sand and this very fine we su gested sifting it to remove the pupæ and larvæ that had left t carrots to transform and burning the siftings; or heat the wh material with hot water. We received the following reply acco panied with fully *two hundred* pupæ and larvæ.

“Pittsfield, Maine, April 11, 1893.

Dear Sir—Your card received. For the information, thank I have sifted part of the sand and burnt the siftings, and put t rest in boiling water. I don't believe those insects will do a more harm. I send another box of them as you requested.

Very truly,

C. H. Morrell.”

After having reared the flies we wrote Mr. Morrell as follows:

“Orono, Maine, May 26, 1893.

Mr. C. H. Morrell:

Dear Sir—I have reared the flies from the pupæ and larv which were affecting your carrots, and am now able to state tha is the “Rust Fly” or “Carrot Fly” an *imported* species from *En land*, which has been giving some trouble since 1886 in Canada b so far as I know, has *never* before been reported from the United States. It is regarded as a very troublesome insect abroad and its introduction here is certainly unfortunate. I am at a loss to suggest how it reached your locality, and will be pleased if you can give me any help in the matter. Have you noticed it before in your place? Please ascertain whether your neighbors have noticed it. Have carrots been imported to your locality, if so, from where? You better watch your carrot bed this season and if the leaves of the young plants turn brown, examine the young roots for the brown rust spots on the surface and the interior for the maggots. If you find them, then after thinning, sift sand saturated with kerosene between the rows, and water heavily to pack the dirt close to the roots so the flies cannot crawl down to lay their eggs.

Respectfully, F. L. Harvey."

We put the larvæ and pupæ sent by Mr. Morrell into sand in a breeding cage and in about two weeks the flies began to emerge in abundance and continued to come out for two weeks. We transferred some males and females to a jar containing parsnips, as we were not able to get carrots. In a day or two we noticed the females crawling between the leaves and going down to the base of them and though we had not observed them mating presumed they were ovipositing. The next day we broke off a leaf and found the eggs near the base laid on the surface in small clusters and loosely attached to the surface of the leaf. Having now eggs, larvæ, pupæ and flies we made out the following description:

Eggs—.6 mm. long (.024 in.) by .115 mm. broad (.0046 in.) white, oblong, about five times as long as broad, longitudinally marked from end to end by about 10 ridges and furrows which are from centre to centre .022 mm. The furrows between the ridges are marked by about thirty circular pits. The sculpture resembles the surface of a peanut. At one end the egg abruptly narrows and bears an oblong pedicil, twice as broad as long, and one-third the width of the egg at the widest part, (.022 mm. x .044 mm.) The pedicilate end of the egg reminds one of a tied grain sack. See Fig. 18.

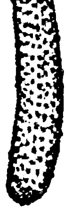


FIG. 18. Egg of Psila rosæ × 50 times. (Original.)

Larvæ—6 mm. long, (.25 in.) breadth 1 mm., (.04 in.) legless, white or pale yellow, semi-transparent, head end quite pointed and armed with a pair of black hooks for gnawing. Aboral end blunt, obliquely docked and bearing on the face of the oblique portion the dark colored caudal spiracles. Third segment from the last longest and somewhat longer than the last two. The sutures between the segment deep. The segments somewhat transversely wrinkled. See Fig. 19.

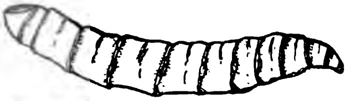


Fig. 19. Psila rosæ. Larva × 8 times (original.)

Pupæ—5 mm. (.20 in.) long, 1 25 mm. (.05 in.) wide, coarctate, brown,obliquely docked behind. The docked portion bordered by a rim and bearing two black tubercles. Fig. 20 shows dorsal and side views. The form of the pupæ is quite variable. Some have two tubercles at the head end and the black candol spiracles show on the oblique end. Some have the sides parallel while others are quite fusiform. The surface is quite wrinkled. Some are fully a fifth longer than others.

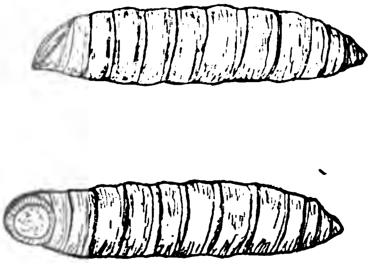


Fig. 20. Psila rosæ. Pupæ × 8 times (original.)

Flies—Length 6 mm. (.25 in.) Wings 3 5 mm. long (14 in.) and extending nearly half their length beyond the abdomen, thin and iridescent. Abdomen and thorax shining pitch black clothed with short grayish pubescence. Head pale orange or yellowish; eyes dark brown; Antennæ basal joint general color of head, terminal joint nearly black, bristles light. A spot above the mouth black, palpi black, proboscis very prominent, oblong and armed with many short hairs. Legs pale yellowish brown. Abdomen ovate. Scutellum raised and bearing two bristles. Arista armed with short hairs. About eight bristles on the mesothorax. The flies have the habit of opening and closing the wings, which are quite iridescent in the sunlight. The males are smaller than the females. Fig. 21 shows the form and veining of the wing. If the veining of the wing s o *Psila rosæ* are correctly shown in the small cut in United States Agricultural Report, 1893, p. 133 then serious doubt arises regarding the determination for the veining of the wings of our specimens are quite different. Probably in so small a cut accuracy was not considered essential.

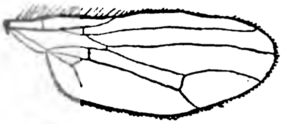


Fig. 21. Psila rosæ, wing × 10 (original.)

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ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

FOR THE

YEAR 1894.

PART II.

PART I–Reports of Trustees, President and Treasurer

PART II–Report of the Director of the Agricultural Experiment Station.

ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

FOR THE

YEAR 1894.

PART II.

Report of the Director of the Agricultural Experiment Station.

AUGUSTA:
BURLEIGH & FLYNT, PRINTERS TO THE STATE.
1895.

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MAINE STATE COLLEGE.

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*Died February 26, 1894.

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TREASURER'S REPORT.

The Maine Agricultural Experiment Station in account with the United States appropriation:

RECEIPTS.

From the Treasurer of the United States as per appropriation for the year ending June 30, 1894	$15,000 00

EXPENDITURES.

Botany and Entomology	$ 25 35	
Chemical Laboratory	215 13	
Expense Account	144 94	
Field and Feeding Experiments	757 04	
Horticultural Department	925 92	
Meteorology	107 02	
Printing	1,397 65	
Construction and Repairs	749 19	
Stationery and Postage	160 80	
Traveling Expenses	226 34	
Library	226 99	
Veterinary Science	52 26	
Fuel	94 40	
World's Fair	16 06	
Heating Apparatus	1,020 91	
Water Supply	150 00	
Salaries	8,730 00	
		$15,000 00

I hereby certify that the above is a correct statement of the amount expended by the Maine Experiment Station for the year ending June 30, 1894.

G. H. HAMLIN, TREASURER,

Trustees of Maine State College of Agr. and the Mech. Arts.

I hereby certify that I have examined the accounts of the Maine Experiment Station for the fiscal year ending June 30, 1894; that I have found the above to be a correct statement of expenditures both as to amount and classification, for all of which, proper vouchers are on file.

HENRY LORD, AUDITOR,

Trustees of Maine State College of Agr. and the Mech. Arts.

DIRECTOR'S REPORT.

A. W. Harris, D. Sc., President Maine State College.

SIR:—I have the honor to submit herewith the report of the work performed by the members of the Experiment Station Staff during the year 1894.

It will be observed that the size of our report for 1894 is no larger and perhaps not so large as those of some previous years. This fact calls for explanation. It is due to several reasons.

1st. All of the work performed in 1894 is not reported. None of the data resulting from the investigations now being conducted in the line of plant nutrition have been published since those secured in the spring of 1893. As this work has consumed much time both in the laboratory and forcing house, its omission from the report has quite a material effect upon its size. Again, an experiment in animal nutrition which has now been continued for over eighteen months has received no mention. The object in withholding these data is that more completeness and definiteness may be secured in the conclusions which we hope to reach.

2nd. The data of our experiments and investigations are not published with that fullness of detail that is sometimes the practice. These details have a permanent record; but it is deemed wise not to confuse those who consult our reports with a large mass of figures and observations that serve to bewilder the reader.

3rd. Considerable of the time of one of the Station chemists was occupied with analyses of samples of suspected butter as an aid to the attempt made by Secretary McKeen to prevent the illegal sale of imitation butter. The attendance of myself and Mr. Bartlett was also required at court several times. The results so far secured seem to have justified the aid given. It is plain that the dairy interests of the State have in this way been materially aided.

REARRANGEMENT OF DUTIES.

The death of Professor Walter Balentine, who had the imme charge of certain lines of Station work, and the consequent tion of myself to the position which he occupied, have led partial rearrangement of the duties of some members of the St Staff. I have undertaken the supervision of the field experir which were under Professor Balentine's care, and the duti the Station chemists, Mr. Bartlett and Mr. Merrill, have enlarged by associating them with the immediate care of the ex ments and investigations in plant and animal nutrition, work previously was entirely superintended by Professor Balentine myself.

SCOPE OF STATION WORK.

In order that the numerous directions along which the activ of the Station Staff are employed may be clearly seen, I marize below the lines of work to which we are giving attentio

I. Experiments and investigations.
  (a) in plant nutrition,
    (1) Forcing house experiments,
    (2) Field experiments.
  (b) in animal nutrition,
    (1) Digestion experiments,
    (2) Animal growth,
    (3) Milk production.
  (c) in horticulture,
    (1) Plant breeding,
    (2) Cultural experiments,
    (3) Prevention of plant diseases and pests
  (d) in economic botany and entomology,
    (1) Weed pests,
    (2) Injurious fungi,
    (3) Injurious insects.
  (e) Bacteriology and veterinary science.
II. Creamery management.
III. Work of inspection.
  (a) Official fertilizer control.
  (b) Inspection of butter samples.
IV. Special analyses.
V. Correspondence.
VI. Institute work.

CORRESPONDENCE.

The amount of correspondence is steadily increasing year by year, and a large amount of time must be used in giving careful replies to the numerous inquiries which we receive concerning a great variety of subjects. The correspondents of the Station do not always receive prompt attention because of the absence at institutes or other work of the person who can give the desired information.

SPECIAL ANALYSES.

Very many requests are made each year to have analyses made of fertilizers, foods, minerals, drinking waters, etc., etc. Some of these requests are granted and others are refused. The reasons for the refusals are various. Sometimes the desired information can be given without analysis. The samples of fertilizers are often from those brands that have had recent inspection and additional analyses are not necessary. Examinations of drinking water are invariably refused as they are not considered as coming properly within the scope of our work. Besides being time-consuming, a mere chemical analysis of a drinking water settles nothing as to its healthfulness, in most cases, and with the additional bacteriological tests which are necessary in order that the results may have a definite value, would seriously interfere with duties that are mandatory.

INSTITUTE WORK.

The members of the Station Staff have freely participated in the institutes held under the auspices of the Board of Agriculture. While this work requires something of a sacrifice of effort, especially on my own part, it is felt to be necessary and profitable. Moreover, a failure to aid in these institutes to the extent that is acceptable would be a poor return for the cordial and helpful attitude which the Secretary of the Board and his associates have taken towards the Station.

PUBLICATIONS.

During the year the Station has issued eleven bulletins, two of which were reports of the inspection of fertilizers, and the others summarized briefly such reports of Station work as admitted of reliable conclusions. Ten thousand of each bulletin are now printed, nearly all of which are distributed in Maine.

Respectfully submitted,
W. H. JORDAN, *Director*.

MAINE STATE COLLEGE,
ORONO, ME., December 31, 1894.

ACKNOWLEDGMENTS.

Acknowledgment is hereby made for the following gifts to the Station:

One Wagner's Dairy Pipette.

As the result of a correspondence with Mr. Bartlett several firms presented to the Station Babcock Milk Testing Machines. These have been placed in the Dairy Building in order that dairy students may have access to them.

Steam Turbine Tester, Stoddard Manufacturing Co., Rutland, Vt.

Two Ten Bottle Hand Machines, Vermont Farm Machine Co., Bellows Falls, Vt.

One Ten Bottle Hand Machine, Cornish, Curtis & Greene, Fort Atkinson, Wis.

The following donations have been made to the Horticultural Department, 1894.

J. J. H. Gregory & Son, Marblehead, Mass., vegetable seeds.
Charles A. Miller, East Union, Me., apple cions.
John Nichols, North Searsport, Me., apple cions.
Division of Pomology, Washington, D. C., apple cions.
R. C. Buckley, Peoria, Ill., Buckley Wheel hoe.
Lucian Saunderson, New Haven, Conn., Comet Bug Killer.

The following newspapers and other publications are kindly donated to the Station by the publishers during 1894:

Farmers' Home, Dayton, Ohio.
Holstein Friesian Register, Boston, Mass.
Farm and Home, Springfield, Mass.
Jersey Bulletin, Indianapolis, Ind.
Farmers' Advocate, London, Ont.
Maine Farmer, Augusta, Maine.
Southern Cultivator, Atlanta, Ga.
American Dairyman, New York, N. Y.

The Sun, Baltimore, Md.
Massachusetts Ploughman, Boston, Mass.
Practical Farmer. Philadelphia, Pa.
New England Farmer, Boston, Mass.
Louisiana Planter, New Orleans, La.
Mirror and Farmer, Manchester, N. H.
Texas Farmer, Dallas, Texas.
Hoard's Dairyman, Fort Atkinson, Wis.
Detroit Free Press, Detroit, Mich.
Orange County Farmer, Port Jervis, N. Y.
Farm Journal, Philadelphia, Pa.
Delaware Farm and Home, Wilmington, Del.
American Cultivator, Boston, Mass.
Farmers' Review, Chicago, Ill.
The Rural Canadian, Toronto, Ont.
Vick's Magazine, Rochester, N. Y.
The Farm and Dairy, Ames, Iowa.
The Clover Leaf, South Bend, Ind.
The Grange Visitor, Lansing, Mich.
The Industrial American, Lexington, Ky.
The American Grange Bulletin and Scientific Farmer, Cincinnati, Ohio.
Agricultural Epitomist, Indianapolis, Ind.
Northern Leader, Fort Fairfield, Me.
American Agriculturist, New York.
American Creamery, Chicago, Ill.
Vermont Farmers' Advocate, Burlington, Vt.
The Farmers' Magazine, Springfield, Ill.
The Dairy World, Chicago, Ill.
The Rural New Yorker, New York, N. Y.
The Homestead, Des Moines, Iowa.
Turf, Farm & Home, Waterville, Me.
The Elgin Daily Reporter, Elgin, Ill.
The Dairy Messenger, Winnetka, Ill.

PARTIAL REPORTS OF THE CHEMISTS.

ANALYSIS OF BUTTER AND IMITATION BUTTER.

J. M. BARTLETT.

The following work on butter and imitation butters was pe formed for the Secretary of the Board of Agriculture to assist hi in enforcing the oleomargarine law for the protection of the dai industry.

The samples were taken by himself or his agent and then turne over to the Station for analysis. As some creameries were accuse of mixing butterine or oleo with their product, a few samples their goods were taken from the open market for examination bu no adulteration was detected. Several of the parties selling tl imitation article illegally were prosecuted, brought to trial an convicted. These trials necessitated the chemist spending sever days at court. The results of the analysis are shown in the follow ing table.

In most of the samples only the volatile fatty acids were dete mined, those being the only ingredients present in fats of the bu ters or butterines, that vary sufficiently to show the source fro which the fat is derived. The results for volatile fatty acids ar expressed in cubic centimeters of one-tenth normal alkali. Thos contained in five grams of pure fat from milk or cream requires 2 to 34. c. c. one-tenth normal alkali to neutralize them, while thos from other sources, such as lard, tallow, etc., require less than c. c. The melting points are of considerable interest and it will b seen that with the exception of three or four samples, butterin has no higher melting point than good creamery butter.

Laboratory number.		Water.	Salt and ash.	Caseine and other organic matter.	Fat.	Volatile fatty acids.	Melting point c.
	S. B. Creamery butter	12.1	2.63	.95	84.32	c. c. 31 35	34.6
	F. C. Creamery butter	12.3	1.93	.93	84.84	30.8	34.2
	L	12.6	4.35	.98	82.07	32.78	34.4
401	XX. Imitation butter	9.06	3.15	.66	87.13	0.8	35.25
402	000	11.46	4.50	1.05	82.99	1.5	34.4
403	L. & W.	10.85	4.49	1.12	83.54	1.25	33.1
404	XXX	9.44	3.25	.69	86.62	1.45	34.8
405	10 lbs	7.9	4.3	1.6	86.2	1.5	36.8
406	K. B	9.5	4.30	.98	85.22	1.6	
407	B. B. Dairy butter	-	-	-	-	31.25	
408	c. c. Dairy butter	-	-	-	-	31.4	
409	230T	6.9	3.37	0.9	88.83	1.4	34.0
410	A. A	-	-	-	-	1.1	36.0
411	19a	-	-	-	-	1.4	33.5
412	37c	10.9	3.43	0.95	84.72	0.85	34.3
413	11L	-	-	-	-	1.6	33.0
414	130L	7.48	3.49	0.79	88.24	1.26	34.3
415	146W. T	-	-	-	-	0.7	34.8
416	222	-	-	-	-	1.35	31.2
417	H. R	-	-	-	-	.85	34.8
418	s. o. p	-	-	-	-	0.1	37.2
419	a. c. g. Dairy butter	-	-	-	-	26.5	

MISCELLANEOUS ANALYSES.

L. H. MERRILL.

In addition to the analytical work attending the fertilizer inspection, in which the writer has had part, he has had charge, during the past year, of the box experiments carried on in the forcing-house. The results of this work will be published later. The following analyses of fodders, Paris green and miscellaneous samples may be given here.

DATA RELATING TO DIGESTION EXPERIMENTS.—COMPOSITION OF FOODS.

	Water.	Ash.	Protein.	Fibre.	Nitrogen free extract.
CCLXIII Hay, fed alone	5.80	4.87	7.00	30.85	48.61
CCLXIV Hay fed with Southern corn silage	6.15	5.04	7.06	30.31	48.39
CCLXV Hay fed with field corn silage	5.62	4.91	7.18	30.37	48.97
CCLXVI Southern corn silage fed alone*	5.68	7.97	10.56	29.03	43.51
CCLXVII Southern corn silage fed with hay*	6.15	7.74	10.44	28.67	42.65
CCLXVIII Field corn silage fed with hay*	7.45	5.42	11.12	20.45	50.98
CCLXXVIII Corn meal, Maine grown	20.09	1.33	10.00	1.57	65.19
CCLXXIX Cotton seed meal	11.73	7.41	45.81	5.62	17.06
CCLXXX Cob meal	19.81	1.49	10.00	7.82	59.88
CCLXXXI Field corn silage fed alone*	5.91	5.17	11.25	20.56	51.50

* Air-dry.

COMPOSITION OF THE FECES.*

Sheep Experiments.	Water.	Ash.	Protein.	Fiber.	Nitrogen free extract.
CCLI Sheep 1, hay alone	5.53	7.51	7.94	34.78	41.31
CCLII Sheep 3, hay alone	5.54	7.41	8.50	33.38	41.63
CCLIII Sheep 4, hay alone	5.63	7.30	8.45	34.66	41.00
CCLIV Sheep 1, Southern corn silage	5.47	10.78	12.00	25.87	42.93
CCLV Sheep 3, Southern corn silage	5.17	11.20	11.81	26.13	42.72
CCLVI Sheep 4, Southern corn silage	5.06	11.15	11.19	26.17	43.73
CCLVII Sheep 1, Southern corn silage and hay	5.57	9.21	9.06	30.54	42.40
CCLVIII Sheep 3, Southern corn silage and hay	5.45	9.13	10.00	30.36	41.94
CCLIX Sheep 4, Southern corn silage and hay	5.04	9.00	9.62	31.75	41.65
CCLX Sheep 1, field corn silage and hay	4.78	9.13	10.75	29.87	42.70
CCLXI Sheep 3, field corn silage and hay	4.60	9.85	11.69	28.15	42.24
CCLXII Sheep 4, field corn silage and hay	4.02	9.40	11.19	30.00	42.33
CCLXXXII Sheep 1, field corn silage	4.50	12.44	14.44	18.39	47.56
CCLXXXIII Sheep 3, field corn silage	3.87	13.33	16.81	18.26	44.34
CCLXXXIV Sheep 4, field corn silage	3.66	13.61	15.00	19.24	45.42

* Air-dry.

PARIS GREEN.

Five samples were examined.

CCLXXXVI. Strictly pure Paris green. Boston Color Co. Sent by John Watson, Houlton.

CCLXXXVII. English pure Paris green. Liverpool Paint and Color Co. Sent by John Watson.

CCLXXXVIII. Strictly pure Paris green. Canada Paint Co. Sent by John Watson.

CCLXXXIX. Strictly pure Paris green. James I. Blanchard. Purchased from Merrill and Nichols, Orono.

CCCII. A sample forwarded by Fred S. Wiggin, Maysville Center. The manufacturer's name was not given.

As the efficiency of Paris green is dependent upon the amount of arsenious acid present, no other ingredient was determined.

CCLXXXVI,	arsenious	acid,	54.61	per	cent.
CCLXXXVII,	"	"	55.39	"	"
CCLXXXVIII,	"	"	54.70	"	"
CCLXXXIX,	"	"	55.84	"	"
CCCII,	"	"	40.86	"	"

The amount of arsenious acid in a good Paris green is somewhat variable ranging from 54 to 61 per cent. The three samples sent by Mr. Watson were reported as failing to give satisfactory results, and adulteration was suspected. As will be seen, however, they all proved good.

SUNDRY ANALYSES.

CCL. Wood Ashes. From B. W. McKeen. Potash 7.82 per cent.

CCCXCIV. Marl. From C. Fred Ames, Fort Fairfield. Carbonate of lime, 83.22 per cent.

CCCXCV. Soil from J. D. Millikin, Scarboro. Water, 40.65. Nitrogen, 1.45. Potash, 0.14. Phosphoric acid, 0.17 per cent.

CCCXCVII and CCCXCVIII. Rock dust. From Maine Red Granite Co., Red Beach, Me.

CCCXCVII. Potash, 4.31 per cent. Phosphoric acid, 0.41 per cent.

CCCXCVIII. Potash, 3.18 per cent. Phosphoric acid, 0.19 per cent.

FIELD EXPERIMENTS WITH FERTILIZERS.

W. H. JORDAN.

One of the oldest, and evidently one of the most popular, clas of experiments conducted by experiment stations is field expe ments in the use of fertilizers. The Maine Station has sha with other stations in this work and is now tilling experimen plots for the eleventh season.

After experience for this length of time, the writer is obliged confess that the results obtained, although valuable enough to well worth securing, are not so satisfactory as are those obtain along some other lines by more accurate and severe metho Field experiments of whatever kind are not subject to exact co trol. They are widely open to sources of error, and for this reas they are difficult of safe interpretation. The publication of single season's results is justified only on the ground of a pardo able ambition to show what and how much a station is trying accomplish, but to draw hard and fast conclusions from one yea results is rarely warranted. After ten years have elapsed, ho ever, the accumulated data possess a significance not possible the early stages of the work. There are presented here therefo not only the unpublished data of several years work but also summary of results secured during nine years.

The problems that have been studied through field experime with fertilizers are those that are plainly indicated by practi work as the important ones.

(1) The relative utility of different forms of phosphoric ac

(2) The effect of partial and complete fertilizers.*

(3) The relative effect of different amounts of fertilizer.

(4) The possibility of maintaining fertility by the use of co mercial fertilizers alone. (Systems of manuring.)

The matter of profit is not immediately connected with th experiments. Indeed it is not possible to order them with ref ence to profit, consequently in their discussion the cost of prod tion is not considered.

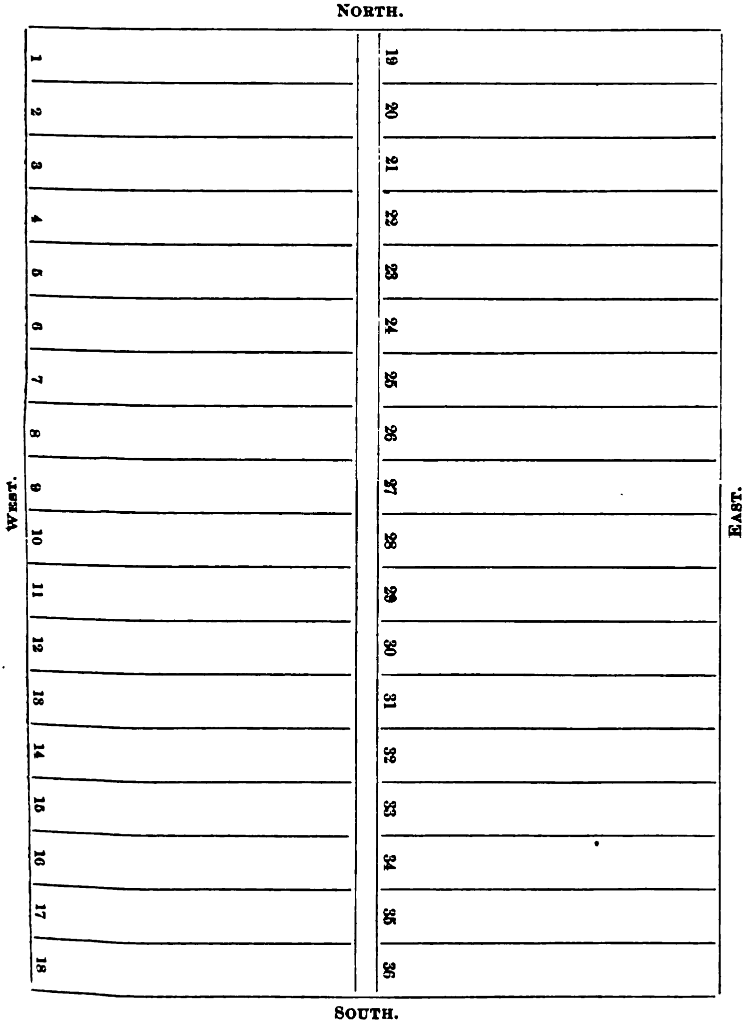
---

*The term complete is used here as meaning a fertilizer that contains nitro phosphoric acid and potash. Such a fertilizer mixed in a particular man may or may not be complete in the sense of supplying the needs of a crop un given conditions.

These experiments involve the use of about twelve acres of land, nearly two acres (Field No. 1) of which are divided into thirty-six plots each 8x1 rods, containing one-twentieth of an acre, and ten acres (Field No. 2) divided into four plots, each two and one-half acres in area. The manner of treating the plots has been described in several previous reports of the Station but is restated in this connection for convenience of reference.

The diagram of field No. I is as follows:

DIAGRAM OF EXPERIMENTAL FIELD NO. 1.



While these plots appear to lie with their side boundaries in c tact, there is really a strip of land eight feet wide separating th This strip gives an opportunity for a ditch that secures sur drainage, and also prevents the fertilizer applied to any plot f having an influence upon those plots adjoining.

Of these thirty-six plots, six have been cropped without addition of any fertilizer whatever. The remaining thirty p have been occupied with ten methods of treatment, three p being treated in the same manner in each case.

The quantities of fertilizers given in the table below are th applied in a single year.**

Plot 1 " 7 " 13	Received no fertilizer.
Plot 2 " 8 " 14	Dissolved bone black, 400* lbs. per acre. Muriate of potash, 100 lbs. per acre. Sulphate of ammonia,¶ 200 lbs. per acre.
Plot 3 " 9 " 15	Fine ground bone, 360 lbs. per acre. Muriate of potash, 100 lbs. per acre. Sulphate of ammonia,¶ 140 lbs. per acre.
Plot 4 " 10 " 16	Fine ground South Carolina rock, 300 lbs. per acre. Muriate of potash, 100 lbs. per acre. Sulphate of ammonia,¶ 200* lbs. per acre.
Plot 5 " 11 " 17	Muriate of potash, 100 lbs. per acre. Sulphate of ammonia, 200 lbs. per acre.
Plot 6 " 12 " 18	Stable manure, 40,000 lbs. per acre.
Plot 19 " 25 " 31	Received no fertilizer.
Plot 20 " 26 " 32	Dissolved bone black, 400* lbs. per acre.
Plot 21 " 27 " 33	Dissolved bone black, 400* lbs. per acre. Muriate of potash, 100 lbs. per acre.
Plot 22 " 28 " 34	Dissolved bone black, 200† lbs. per acre. Muriate of potash, 50 lbs. per acre. Sulphate of ammonia,¶ 60 lbs. per acre.
Plot 23 " 29 " 35	Dissolved bone black, 300‡ lbs. per acre. Muriate of potash, 100 lbs. per acre. Sulphate of ammonia,¶ 120 lbs. per acre.
Plot 24 " 30 " 36	Dissolved bone black, 400* lbs. per acre. Muriate of potash, 150 lbs. per acre. Sulphate of ammonia,¶ 180 lbs. per acre.

**Dissolved bone black was used as one source of phosphoric acid from 18 1889 inclusive, after which dissolved South Carolina rock was used instead.

*Or dissolved South Carolina rock, 500 lbs.

†Or dissolved South Carolina rock, 250 lbs.

‡Or dissolved South Carolina rock, 375.

¶Or nitrate of soda.

The history of these plots is summarized below.

Year.	Crop.	Treatment.
1886,	Oats,	Fertilizers applied.
1887,	Oats,	Fertilizers applied.
1888,	Hay,	No fertilizers.
1889,	Fallowed,	Fertilizers applied.
1890,	Peas,	No fertilizers.
1891,	Oats,	No fertilizers.
1892,	Peas,	No fertilizers.
1893,	Corn,	Fertilizers applied.
1894,	Corn,	Fertilizers applied.

It appears then that in nine years five applications of fertilizer have been made and eight crops produced.

Since 1891 no statement of the crops grown has been published. In order that these results may have a permanent record the yields from these plots in 1892, 1893 and 1894 are given in Table 1, after which the production for the nine years is condensed in a proper form for comparison.

TABLE I.

FERTILIZERS APPLIED PER ACRE AND YIELD PER PLOT, 1892, 1893, 1894.

	Fertilizers as applied in 1886, 1887, 1889, 1893 and 1894. None used in 1888, 1890, 1891 and 1892.	1892. Crop, Peas.			1893. Crop, corn, green weight.
		Grain.	Straw.	Total.	
Plot 1	No manure.	15.5	22.5	37	80
Plot 7		8.5	16.5	25	100
Plot 13		12	17	29	70
Plot 2	Fertilizer from 400 lbs. dissolved bone black,* 100 lbs. muriate of potash and 200 lbs. sulphate of ammonia,† mixed.	19	9	28	225
Plot 8		21	8.5	29.5	350
Plot 14		16.7	10.3	27	295
Plot 3	Fertilizer from 360 lbs. ground bone, 100 lbs. muriate of potash and 200 lbs. sulphate of ammonia,† mixed.	13.5	9.5	23	305
Plot 9		21.7	9.8	31.5	315
Plot 15		17	9	26	280
Plot 4	Fertilizer from 300 lbs. fine ground South Carolina rock, 100 lbs. muriate of potash and 200 lbs. sulphate of ammonia,† mixed.	14.7	9.3	24	175
Plot 10		16.5	6	22.5	330
Plot 16		10.3	7.7	18	200
Plot 5	Fertilizer from 100 lbs. muriate of potash, 200 lbs. sulphate of ammonia,† mixed.	15	10	25	175
Plot 11		23.5	13.5	37	205
Plot 17		17	9.5	26.5	225
Plot 6	Fertilizer, 40,000 lbs. stable manure.	26.5	9.5	36	490
Plot 12		22.5	17.5	40	460
Plot 18		55	17	72	650
Plot 19	No manure.	24.5	12	36.5	60
Plot 25		14.5	10.5	25	125
Plot 31		15	12	27	50
Plot 20	Fertilizer, consisting of 400 lbs. dissolved bone black alone.*	13.3	5.7	19	90
Plot 26		8	4.5	12.5	155
Plot 32		12	6.5	18.5	120
Plot 21	Fertilizer from 400 lbs. dissolved bone black,* 100 lbs. muriate of potash, mixed.	12.5	5.5	18	270
Plot 27		10	5	15	345
Plot 33		12.5	9.5	22	270
Plot 22	Fertilizer from 200 lbs. dissolved bone black,‡ 50 lbs. muriate of potash and 60 lbs. sulphate of ammonia,† mixed.	15	8	23	175
Plot 28		11	6.7	17.7	235
Plot 34		13	10	23	180
Plot 23	Fertilizer from 300 lbs. dissolved bone black,‖ 100 lbs. muriate of potash and 120 lbs. sulphate of ammonia,† mixed.	16.5	6.5	23	265
Plot 29		21.7	9.3	31	230
Plot 35		17.5	10.5	28	235
Plot 24	Fertilizer from 400 lbs. dissolved bone black,* 150 lbs. muriate of potash and 180 lbs. sulphate of ammonia,† mixed.	19.5	7.5	27	365
Plot 30		22.7	4.3	27	355
Plot 36		20.5	7	27.5	39

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* Or 500 lbs. dissolved South Carolina rock.

‡ Or 250 lbs. dissolved South Carolina rock.

‖ Or 375 lbs. dissolved South Carolina rock.

† Or same weight nitrate of soda.

In 1893 fifty pounds of corn were selected from each plot, ing 150 pounds for each set of three plots. This was stored i barn for a time and was then weighed, chopped and sam The samples were dried in a closet heated by steam, and after standing in the air of an ordinary room for several were weighed. These weights were taken as those in the air dry condition. In 1894 practically the same course was pursued only the samples were selected for drying as the corn was chopped for the silo in the fresh green state. The moisture in the air-dry samples for 1894 was also determined in order to ascertain the yield of dry matter. (See Table 2.)

TABLE II.

	1893—Air dry material per cent from green corn.	1894.	
		Air dry material per cent from green corn.	Per cent of dry matter in green corn.
Plots 1, 7, 13	23.7	21.4	19.8
Plots 2, 8, 14	24.4	24.3	22.4
Plots 3, 9, 15	22.1	24.0	22.0
Plots 4, 10, 16	22.9	25.2	23.4
Plots 5, 11, 17	22.4	22.0	20.4
Plots 6, 12, 18	27.5	21.2	19.8
Plots 19, 25, 31	24.4	18.8	17.3
Plots 20, 26, 32	23.6	19.0	17.5
Plots 21, 27, 33	25.2	21.1	19.7
Plots 22, 28, 34	23.9	20.1	18.5
Plots 23, 29, 35	19.9	20.3	18.8
Plots 24, 30, 36	27.5	*21.5	*20.0

* Assumed.

By the use of the foregoing data the production of air dry material in the corn for the years 1893 and 1894 is calculated.

The succeeding table (Table 3) shows the yield of air dry material from the crops under consideration since the experiments were begun in 1886.

The quantities stated represent the rate of production of per acre. The data for the years previous to 1892 have been copied from the reports of these experiments published up to that time.

TABLE III.

SUMMARY OF YIELD PER ACRE OF FIELD NO. 1, FOR EIGHT YEARS

		No fertilizer. Plots 1, 7, 13.	Complete fertilizer, phosphoric acid from dissolved bone black. Plots 2, 8, 14.	Complete fertilizer, phosphoric acid from ground bone. Plots 3, 9, 15.	Complete fertilizer, phosphoric acid from crude South Carolina rock. Plots 4, 10, 16.	Only nitrogen and potash applied. Plots 5, 11, 17.
1886, Oats	Grain	1,670	2,486	2,286	2,166	1,9
	Straw	1,994	3,414	3,134	2,886	2,5
	Total	3,664	5,900	5,420	5,052	4,5
1887, Oats	Grain	800	1,160	956	1,064	1,0
	Straw	1,200	2,240	1,610	2,036	1,6
	Total	2,000	3,400	2,566	3,100	2,7
1888, Hay		2,566	2,434	2,800	2,566	2,2
1889, Fallow						
1890, Peas	Grain	742	902	946	848	7
	Straw	664	948	976	914	6
	Total	1,406	1,850	1,922	1,762	1,4
1891, Oats	Grain	1,166	1,346	1,376	1,160	1,2
	Straw	726	986	1,090	776	7
	Total	1,892	2,332	2,466	1,936	2,0
1892, Peas	Grain	468	368	376	308	4
	Straw	748	756	696	552	7
	Total	1,216	1,124	1,072	860	1,1
1893, Corn	Green	1,666	5,800	6,000	4,700	4,0
	Air-dry	395	1,415	1,326	1,076	9
1894, Corn	Green	3,500	12,040	12,660	10,440	8,5
	Air-dry	749	2,926	3,038	2,631	1,8
	Dry matter	698	2,697	2,785	2,443	1,7
Total yield, 8 crops		13,888	21,381	20,610	18,983	16,8
Increase of yield over plots without fertilizer			7,331	6,560	4,933	2,7
Annual increase			916	820	617	34

TABLE III—CONTINUED.

		No fertilizer. Plots 19, 25, 31.	Phosphoric acid alone. Plots 20, 26, 32.	Phosphoric acid and potash. Plots 21, 27, 33.	Complete fertilizer, 380 lbs. per acre. Plots 22, 28, 34.	Complete fertilizer, 585 lbs. per acre. Plots 23, 29, 35.	Complete fertilizer, 830 lbs. per acre. Plots 24, 30, 36.
1886, Oats	Grain	1,574	1,656	1,630	1,726	2,070	2,040
	Straw	2,394	2,856	3,276	3,006	3,570	3,994
	Total	3,968	4,512	4,906	4,732	5,640	6,034
1887, Oats	Grain	846	870	732	900	858	1,214
	Straw	1,554	1,230	1,902	1,934	2,642	2,620
	Total	2,400	2,100	2,634	2,834	3,500	3,834
1888, Hay		1,634	2,166	2,066	2,166	1,766	2,374
1889, Fallow.							
1890, Peas	Grain	764	852	958	894	822	954
	Straw	854	922	1,020	844	872	824
	Total	1,618	1,774	1,978	1,738	1,694	1,778
1891, Oats	Grain	1,192	1,256	1,264	1,202	1,278	1,278
	Straw	876	1,410	1,404	1,294	1,422	1,388
	Total	2,068	2,666	2,668	2,496	2,700	2,666
1892, Peas	Grain	460	224	268	328	348	248
	Straw	720	444	468	520	744	836
	Total	1,180	668	736	848	1,092	1,084
1893, Corn	Green	1,500	2,440	5,900	3,940	4,860	7,440
	Air-dry	366	576	1,486	942	967	2,046
1894, Corn	Green	5,260	6,740	12,000	9,860	12,800	15,940
	Air-dry	978	1,280	2,532	1,982	2,598	3,427
	Dry matter	910	1,179	2,364	1,824	2,406	3,188
Total yield, 8 crops		14,212	15,742	19,006	17,738	19,957	23,243
Increase of yield over plots not fertilized			1,690	4,956	3,688	5,907	9,193
Annual increase			211	619	461	738	1,149

The previous tables present a statement of the production of the entire system of plots, without any special classification of the results with reference to the problems involved. Such a classification is necessary in order to discover more clearly the nature of the testimony offered.

THE RELATIVE UTILITY OF DIFFERENT FORMS OF PHOSPHORIC ACID.

Ever since commercial fertilizers have come into general use more or less discussion has been carried on as to the value of insoluble phosphates as a source of phosphoric acid. This discussion has been chiefly caused by the fact that phosphoric acid has cost much less in the crude condition than after treatment with sulphuric acid. It has been generally conceded that the less soluble and cheaper form of plant food is more likely to prove useful in grass and grain growing than with hoed crops, because in the first case permanency of effect is desired and in the latter, immediate availability is the essential thing.

It is true, however, that in later years we have come to more fully appreciate the ability of plants to make their own solutions of food from the minerals of the soil that are highly inert so far as it is a question of solution in water, and we have known for a long time that the water-soluble phosphates of fertilizers revert very rapidly after contact with the soil to these forms that are easily dissolved only by acids, the chief advantage secured by the manufacture of a superphosphate being that its compounds become distributed in the soil in a more finely divided condition than is possible in any other way and so become more fully accessible to root action. The results of these experiments are in accord with the tendency to accord to insoluble phosphates a larger place in practice. (See Table 4.)

TABLE IV.

	Yield per acre of air-dry crops.		
	Total yield in 8 years.	Total excess of yield over plots not fertilized.	Annual excess of yield over plots not fertilized
	lbs.	lbs.	lbs.
Plots receiving no fertilizer (average of 6)	14,050		
Complete fertilizer, phosphoric acid largely dissolved.	21,381	7,331	916
Complete fertilizer, phosphoric acid from ground bone,	20,610	6,560	820
Complete fertilizer, phosphoric acid from crude ground South Carolina rock	18,983	4,933	617
Fertilizer containing nitrogen and potash, but no phosphoric acid	16,820	2,770	346

We have in the above figures conclusive evidence that the phosphoric acid of the bone and ground South Carolina rock was quite freely appropriated, though not to the same extent as from the dissolved phosphate.

The quantities stated are the total crop harvested in eight years. Another arrangement of figures is necessary to show whether the increased yield occurred with all crops alike is only with certain ones. With the exception of the hay, only those crops are given in Table 5 which were the first ones grown after the application of the fertilizers.

TABLE V.

	Excess of yield over plots not fertilized.					
	Oats. 1886.	Oats. 1887.	Hay. 1888.	Peas. 1890.*	Corn. 1893.	Corn. 1894.†
Complete fertilizer, phosphoric acid dissolved	2,236	1,400	—132	444	1,020	2,004
Complete fertilizer, phosphoric acid from ground bone	1,756	566	234	516	831	2,092
Complete fertilizer, phosphoric acid from crude South Carolina rock	1,388	1,100	-	356	681	1,750
Nitrogen and potash without phosphoric acid	836	700	—332	16	510	1,049

* Fertilizers applied in 1889, and land summer fallowed.

† Yield of dry matter.

In the light of the facts here presented it is necessary to admit that the water-insoluble forms of phosphoric acid have been utilized by at least three species of farm crops.

THE EFFECT OF PARTIAL AND COMPLETE FERTILIZERS.

It has for some time been well enough established that under average conditions a complete fertilizer, viz: one containing compounds of nitrogen, phosphoric acid and potash causes a larger increase of crop than a fertilizer containing only one or two of these ingredients. It is equally plain that one ingredient often has a preponderating influence, and more often two of these ingredients combined are nearly as useful as the three. Unfortunately the results of experiments in a particular locality do not with any certainty apply to any other locality as indicating the special needs of the soil, and these experiments at the College were not undertaken with the idea of establishing formulæ of general use in the State.

It seemed desirable, however, to ascertain what would be the outcome of fertilizing continuously with partial fertilizers in a soil that has seemed to especially need the mineral ingredients. This can be seen in Table VI.

TABLE VI.

	Yield per acre of air-d crops.		
	Total yield in 8 years.	Total increase of yield over plots not fertilized.	Annual increase of yield
Plots receiving no fertilizer (average of 6).	14,050		
Fertilizer supplying only phosphoric acid.............	15,742	1,690	
Fertilizer supplying phosphoric acid and potash......	19,006	4,956	
Fertilizer supplying nitrogen and potash..............	16,820	2,770	
Fertilizer supplying nitrogen, phosphoric acid and potash..	21,381	7,331	

While there is certainly an increase of crop from every combi tion of ingredients used, there is no doubt of the superior influe of the mixture of the three.

THE RELATIVE EFFECT OF DIFFERENT AMOUNTS OF FERTILIZER

One of the important considerations pertaining to the use of co mercial fertilizers is the quantity to be applied. In these exp ments the amount of complete fertilizer applied per acre on one of three plots has been at the rate of 360 pounds per acre, another set 595 pounds and on a third set 830 pounds. The resu show that the increase of production has been almost directly p portional to the amount of fertilizer used.

TABLE VII.

	Total yield in 8 years.	Total increase of yield over plots not fertilized.	Increase of yield for each
Plots receiving no fertilizer (average of 6)	14,050		
Plots receiving 360 lbs. fertilizer per acre	17,738	3,688	
Plots receiving 595 lbs. fertilizer per acre	19,957	5,907	
Plots receiving 830 lbs. fertilizer per acre	23,243	9,193	

THE COMPARATIVE RESULTS WITH COMMERCIAL FERTILIZERS AND WITH STABLE MANURE.

The figures contained in the succeeding table should be suggestive to two classes of farmers: (1) Those who are skeptical about the real value of commercial manures for feeding plants, and (2) those who carelessly allow a waste of plant food from the stable which is no less valuable than that which is purchased.

TABLE VIII.

	Yield per acre of air-dry fodder.		
	Total yield in 8 years.	Total excess of yield over plots not fertilized.	Annual excess of yield over plots not fertilized.
Plots receiving no fertilizer	14,050		
Plots receiving 360 lbs. fertilizer per acre	17,738	3,688	461
Plots receiving 595 lbs. fertilizer per acre	19,957	5,907	738
Plots receiving 800 lbs. fertilizer per acre	21,381	7,331	916
Plots receiving 830 lbs. fertilizer per acre	23,243	9,193	1,149
Plots receiving 40,000 lbs. stable manure per acre	26,751	12,701	1,588

The fact of greater production from the stable manure than from the commercial fertilizers is what would reasonably be expected when we consider the larger amount of plant food contained in the former. If the stable manure was of average composition, and it was at least as rich as that, the quantities of plant food supplied would not be far from the following:

TABLE IX.

	Applied per acre.		
	Nitrogen—lbs.	Phosphoric acid—lbs.	Potash—lbs.
In 40,000 lbs. stable manure	196	128	176
In the largest amount commercial fertilizers	30 to 40	75	75

It seems quite evident that a larger percentage of the mate furnished by the commercial fertilizers has been appropriate the growing crops than was the case with the stable manure. may due, however, to the smaller supply from commercial sou

SYSTEMS OF MANURING.

In 1888 this Station began a field experiment upon a some large scale, which was designed for the purpose of securing in mation on two points of great practical interest:

1st. The possibility of maintaining soil fertility by the us commercial fertilizers alone.

2nd. The comparative value for general farming of crude dissolved phosphates.

This experiment was under the immediate direction of Profe Walter Balentine until his death in 1894 when it passed to the of the writer. The data from four years work are given in Station reports for 1890 and 1891 but for various reasons no re has been made of the results reached since the season of 1891 which time the plot were sown to oats and seeded with tim and clover. In reporting the additional data secured, it app desirable to restate the plan and conditions of the experiment summarize the seven years results.

The experimental field consists of ten acres, divided into plots of two and one-half acres each. The treatment decided u for each of these plots was as follows:

EXPERIMENTAL FIELD No. 2.

North.

No. 1. 20 loads (6⅔ cords) Stable Manure per acre.	2½ Acres.
No. 2. 1,000 lbs. South Carolina Rock, 66 lbs. nitrate of soda, 16 lbs. sulphate of ammonia, 100 lbs. muriate of potash per acre.	2½ Acres.
No. 3. 500 lbs. Acid South Carolina Rock, 66 lbs. nitrate of soda, 16 lbs. sulphate of ammonia, 100 lbs. muriate of potash per acre.	2½ Acres.
No. 4. No manure.	2½ Acres.

South.

In 1890 the fertilizers were applied, since which four crops have been grown. In 1891 the plots were sown to oats and seeded to clover, but this was all killed during the succeeding winter, so that the land was again plowed in the spring of 1892 and sown to barley, which was cut and cured for hay. During the summer of 1893 the plots were kept fallow and tilled as an attempt to eradicate certain most pernicious cruciferous weeds. In 1894 the land was again sown to oats, but as the crucifers were not all exterminated and it was desirable that they should not ripen and scatter their seeds, the oats were cut before maturing and used for silage.

Large samples (1,000 pounds from each plot) of the green oats were selected and cured, from which smaller samples of air-dry material were taken in order to determine the percentage of dry matter in the crop as cut.

TABLE X.

YIELD PER ACRE FOR THE YEARS 1888 TO 1894, INCLUSIVE.

		Plot 1. Barn manure.	Plot 2. Phosphoric acid, crude.	Plot 3. Dissolved phosphate.	Plot 4. Nothing.
		lbs.	lbs.	lbs.	lbs.
Hay, average yield 1888 and 1889		2,542	2,416	2,082	2,510
Barley and peas, combined yield, 1890*		2,208	1,712	1,422	1,118
Oats, 1891.	Grain	1,536	1,447	1,523	1,304
	Straw	2,282	1,534	1,449	1,176
	Total	3,818	2,981	2,972	2,480
Barley hay, 1892		3,444	2,324	1,930	1,161
Summer tilled, 1893.					
Oats, 1894.	Green crop	9,968	10,264	7,608	6,340
	Dry matter	1,894	2,453	1,734	957.3
Yield without fertilizers as calculated from the relative production of 1888-1889		966	919	766	957.3
Gain caused by fertilizers in 1894		928	1,534	968	

*Fertilizers applied this year.

The plots have been treated during the seven years from 1888 to 1894 inclusive as shown by the summary given below:

Year.	Manuring.	Crop produced.
1888,	No fertilizer,	Grass.
1889,	No fertilizer,	Grass.
1890,	Fertilizer applied,	Peas and barley.
1891,	No fertilizer,	Oats, seeded down.
1892,	No fertilizer,	Barley, cut for hay.
1893,	No fertilizer,	Summer fallowed and tilled.
1894,	No fertilizer,	Oats, cut green for silo.

It seems that during seven years the plots have produced six crops, have received one application of the fertilizers and have been summer tilled once. Two years were allowed to elapse before any fertilizer was applied, during which time the grass crop was cut and the hay weighed, in order to ascertain the relative natural productiveness of the plots before receiving special treatment.

The above figures effectually answer the question so often proposed by farmers, "Do commercial fertilizers have influence upon more than the first crop succeeding their application?"

In this instance the fertilizers were applied in 1890 and at the end of the season of 1894 five crops of grain had been removed without any further manuring, but even after the growth of three previous crops the one of 1894 shows in a marked manner the influence of the fertilizers used in 1890. It is too early however, to reach any conclusion as to whether commercial fertilizers can be depended upon as a source of fertility for all time.

This experiment has already furnished a bit of not insignificant testimony on the use of raw ground mineral phosphates, for grain growing at least. Plots two and three were treated exactly alike excepting that the phosphoric acid applied to plot three was chiefly in the soluble and reverted form, while on plot two it was used in much larger quantities almost wholly in the insoluble form. In other words, an acid or soluble phosphate was used on plot three and a crude ground phosphate on plot two.

TABLE XI.

INGREDIENTS APPLIED IN COMMERCIAL FERTILIZERS ON PLOT TWO AND THREE.

	Plot 2—pounds.	Plot 3—pounds.
Phosphoric acid, mostly dissolved	-	80
Phosphoric acid, undissolved	250	
Potash	50	50
Nitrogen	14	14

With the exception of the oat crop of 1891 the production of plot two has largely exceeded that of plot three. Especially is this true of the 1894 crop after the exhausting effect of three years of cropping. In this year the greater productiveness of plot two is very marked, the excess of yield being 566 pounds of dry matter. This is certainly one instance of the unmistakable persistent influence of a crude phosphate in increasing the growth of a field crop.

In comparing the relative effect of the barn manure and the commercial fertilizers it is clearly seen that for the first three crops the former caused the greater increase of production. If we compare the plant food furnished to each of the several plots, this appears to be a most natural result as much the larger amount was applied to the barn manure plot.

TABLE XII.

PLANT FOOD SUPPLIED TO THE SEVERAL PLOTS.

	Nitrogen—pounds.	Phosphoric acid—pounds.	Potash—pounds.
Plot 1	172	116	176
Plot 2	14	250	50
Plot 3	14	80	50
Plot 4	0	0	0

Only in the case of the phosphoric acid of Plot 2 do the commercial manures exceed or even approach in quantity the plant food furnished by the stable manure. This greater amount of plant food does not fail of its effect, but it is worthy of remark that after three crops have been removed the yield of Plot 1 is inferior to that of Plot 2 and scarcely greater than that of Plot 3. A possible explanation of this is that the soil is especially lacking in available phosphoric acid and therefore the larger amount of this compound applied to Plot 2 resulted in a more persistent increase of crop. These results so far run counter to the prevailing views as to the relative permanence of effect of animal and commercial manures.

But the experiment is still in progress and definite conclusions should be withheld for some years.

The following, however, is a brief summary of the more important facts to date, as bearing upon the experiment on Field 2:

(1) The commercial fertilizers have caused a marked increase of crop for at least four years after their application.

(2) The fourth crop was larger from the crude phosphate than from the dissolved.

(4) The first three crops were larger from the yard manure than from the commercial manures but the fourth crop was larger from the latter.

THE PROFITABLE AMOUNT OF SEED PER ACRE FOR CORN.

W. H. JORDAN.

The opinion has prevailed somewhat in the past, if a practice is any indication of an existing opinion, that the larger the amount of seed used the greater the yield of corn for soiling or fodder purposes.

In many instances not less than a bushel of corn has been sown per acre on the plot that was to furnish fodder corn in late August and during September. The resulting product has always been a large weight of immature, very watery fodder.

Possibly the practice was correct if we assume that the gross weight of a green crop is a correct measure of its value.

We know that this is not the case, but, that the value of any crop is chiefly measured by its yield of dry matter, and we have found out that the largest food product is obtained when the amount of seed approximates, at least, to that planted in ordinary field culture. More or less discussion still exists, however, in regard to the exact quantity of seed that is conducive to the maximum yield. A very common custom is to plant five kernels in a hill with the rows three and one-half feet apart and the hills three feet. This is nearly equivalent to rows the same distance with single kernels drilled in at a distance of seven inches apart.

During the past season an experiment has been carried on by the Station for the purpose of ascertaining the amount of seed most profitable in corn raising.

A plot of one acre was used for this purpose. This plot received five cords of manure and five hundred pounds of commercial fertilizer. It was divided into twelve plots, or four sets of plots with three plots in a set.

On one plot in each set the single kernels were planted six inches apart, on another nine inches, and on the third twelve inches. This gave four plots or one-third of an acre planted by each method. The corn was allowed to stand until the kernels glazed and was then cut, weighed and sampled.

Below can be seen the gross yield of crop per acre, the percentage and the total yield of dry matter.

TABLE XIII.

	Yield of green crop per acre.	Per cent of dry matter in green crop.	Yield of dry matter per acre.
Kernels 6 inches apart or 6 in three feet	21,315	21.1	4,497
Kernels 9 inches apart or 4 in three feet	22,530	20.9	4,708
Kernels 12 inches apart or 3 in three feet	20,190	20.5	4,139

In this instance at least the medium quantity of seed, viz: Four kernels in each three feet, produced the largest yield of both green crop and dry matter. Several similar trials will be made to determine whether this will uniformly occur.

It appears that the corn from the different quantities of seed was of practically uniform composition.

TABLE XIV.

	Water.	Ash.	Protein.	Fiber.	Nitrogen free-extract.	Fats.
Planted with kernels 6 inches apart	78.90	1.09	1.87	4.30	13.07	.76
Planted with kernels 9 inches apart	79.10	1.35	2.02	3.73	12.97	.83
Planted with kernels 12 inches apart	79.50	1.01	1.85	4.40	12.52	.72

DIGESTION EXPERIMENTS.

THE INFLUENCE OF FOOD COMBINATIONS UPON DIGESTIBILITY.

W. H. JORDAN.

A large amount of time has been expended in determining the digestibility of our various cattle foods, and the figures obtained are known as coefficients of digestibility. These coefficients are arranged in tables convenient for reference, and are much used in a practical way for the calculation of rations. In practice it is assumed that when the several materials in the ration are multiplied by their respective percentages of digestibility, the sum of the quantities thus obtained will represent very nearly the total digestible material fed; in other words, it is assumed that no matter how foods are combined, each food continues to have its peculiar rate of digestibility, which is not changed to any important extent by the influence of the foods which accompany it.

The correctness of the position is somewhat questioned by those familiar with related facts, their doubt being based not so much upon theoretical reasons as upon the apparent outcome of certain digestion experiments.

The digestibility of a food in a particular instance must be determined by two factors:

(1) What has been termed the "inherent resistance" of the food to the solvent action of the digestible liquids.

(2) The supply in abundance of these digestive fluids.

The writer has always inclined to the view that the first factor is so largely the controlling one that unless the animal is under abnormal conditions it almost wholly determines the amount of the food that shall pass into solution. To illustrate, egg albumen is wholly peptonized by the gastric juice, or starch is wholly inverted to glucose under the action of the pancreatic juice, and these results will always obtain when these two juices are secreted in proper abundance, not being influenced by the relative amounts present of other compounds that are to be digested. There is a possibility that a food may be so distasteful to the animal that the nerve stimulus necessary for the proper secretion of the digestive fluids may be wanting, and in such a case the addition to the ration of anything that would render it more palatable would promote digestibility, but with healthy animals judiciously fed on the ordinary food mixtures, we have no reason to suspect either unpalatableness or an insufficient supply of the digestive juices.

One difficulty in obtaining conclusive testimony on the point under consideration lies in the limitations of digestion experiments, which with ruminants, at least, do not allow the determination of the digestibility of all foods as fed singly.

The co-efficients of digestibility of grains with ruminants have been reached by assuming coarse fodders to have the same digestibility when fed with them as when fed alone. We do not know how much of the grains would be digested when not accompanied by any other food, nor do we know if hay maintains the same digestibility when grains are combined with it. The way by which we can get at the most reliable figures is to experiment with foods that it is practicable to feed both singly and combined.

The digestion experiments at this Station in 1894 have been directed toward gaining information on the points under consideration.

The experimental foods have been Timothy hay and silage. If combination does affect digestibility, it would be likely to occur when two such foods as these are mixed,—the one coarse, dry, quite indigestible and not highly palatable, and the other succulent, much more digestible and very much relished by the animals.

The experiments were conducted with the foods alone and combined, using Timothy hay, silage from the large immature Southern corn and silage from mature Flint corn. The following is a summary of the results:

	Coefficients of digestibility.						
	Dry matter.	Ash.	Organic substance.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
Timothy hay, 600 grs. daily, Sheep 1	54.4	28.8	55.7	48.2	48.7	61.3	57.2
Sheep 2......	52.7	28.2	54	42.7	48.9	59.6	41.8
Sheep 3......	54.1	31.3	55.3	44.7	48.5	61.2	52.7
Average	53.7	29.4	55	45.2	48.7	60.7	50.6
Silage, Southern corn, 2,000 grs. daily. Sheep 1......	64.6	52.3	65.7	59.8	68.5	65.1	67.8
Silage, Southern corn, *2,500 grs. daily. Sheep 2	64.5	50	65.8	60.4	68.2	65.3	67.6
Silage, Southern corn, 2,500 grs. daily. Sheep 3......	61.8	46.5	63.1	59.7	65.8	61.8	68.4
Average	63.6	49.6	64.8	59.9	67.5	64.1	67.9
Silage, Maine Flint corn, 2,000 grs. daily. Sheep 1......	75.1	41	77.2	68.5	78.1	77.4	88.5
Sheep 2......	76	39.4	78.2	64.9	79.2	79.8	85.8
Sheep 3......	76.2	39	78.4	68.9	78.2	79.5	87.2
Average	75.7	39.8	77.9	67.4	78.5	78.9	87.1
Combination Southern corn silage and hay. Sheep 1......	55.1	30.6	56.8	50.9	54.2	59.3	59
Sheep 2......	58.9	38.4	60.3	52	56	62.9	64.4
Sheep 3......	57	37.4	58.4	51.4	53.9	61.7	65
Average	57	36.6	58.5	51.4	54.7	61.3	62.8
Combination field corn silage and hay. Sheep 1......	73.6	49	74.8	68.6	70.3	77.8	80.4
Sheep 2......	66.4	-	68.1	56.7	64.4	72.1	68.7
Sheep 3......	67.1	-	68.6	59.6	63.1	72.7	73.2
Average sheep 2 and 3	66.7	-	68.3	58.1	63.7	72.4	70.9

* For analyses of materials see report of L. H. Merrill.

It will be observed that the digestibility of both the hay and the silages was determined with these foods when eaten alone.

Having these figures it is possible to calculate the digestibility of a known mixture of hay and silage, assuming that the one has no influence on the other. But this is the point in question and in Tables XV and XVI we have a comparison of the theoretical digestibility with what actually occurred.

TABLE XV.

COMBINATION OF HAY AND SOUTHERN CORN SILAGE.

SHEEP 1.	Dry matter.	Ash.	Organic matter.	Protein.	Fiber.	Nitrogen free-extract.	Fats.
Dry matter eaten	2,005	127.4	1,877.4	175.6	635	992.1	74.7
Dry matter actually digested	1,106	39	1,066.8	89.4	344.3	588.3	44.9
Amount digested as calculated from results with foods fed singly	1,161	-	1,099.1	93.5	350.9	620.1	46.1
Per cent actually digested	55.1	30.6	56.8	50.9	54.2	59.3	59
Per cent digested as per calculation	57.9	-	58.5	53.2	55.2	62.5	61.7
SHEEP 2.							
Dry matter eaten	2,177.5	141.6	2,035.7	194.8	687.6	1,070.6	82.6
Dry matter actually digested	1,282.4	55.2	1,227	100.2	400.8	673.3	53.2
Amount digested as calculated from results with foods fed singly	1,219.4	-	1,192.8	100	387	660.5	44.6
Per cent actually digested	58.9	-	60.3	52	58.2	62.9	64.4
Per cent digested as per calculation	57.4	-	58.6	52	56.4	61.7	54.2
SHEEP 3.							
Dry matter eaten—same as Sheep 2							
Dry matter actually digested	1,241.7	53	1,188.5	100	374.8	659.9	53.7
Amount digested as calculated from results with foods fed singly	1,244.4	-	1,187.5	101.5	379	657.6	49.8
Per cent actually digested	57	-	58.4	51.4	53.9	61.7	65
Per cent digested as per calculation	57.1	-	58.3	52.1	55.1	61.4	60.3
Average per cent actually digested	57	-	58.5	51.4	55.4	61.3	62.8
Average per cent digested as per calculation	57.4	-	58.5	52.4	55.5	61.9	58.7

TABLE XVI.

COMBINATION OF HAY AND FIELD CORN SILAGE.

SHEEP 1.	Dry matter.	Ash.	Organic matter.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
Dry matter eaten..........	2,297	115.8	2,171.1	218.1	639.5	1,223.7	89.7
Amount actually digested........	1,690.5	57	1,623.4	149.6	449.2	952.3	72.1
Amount digested as calculated from results with foods fed singly..	1,454	-	1,409	129.2	375.5	837.7	66.6
Per cent actually digested*	73.6	49	74.8	68.6	70.3	77.8	80.4
Per cent digested as per calculation	63.3	-	64.9	59.2	58.7	68.5	74.2
SHEEP 2.							
Total fed—same as Sheep 1.							
Amount actually digested.........	1,525.2	36.2	1,479	123.6	411.8	881.9	61.6
Amount digested as calculated from results with foods fed singly............................	1,440.6	-	1,397 3	119.4	378.8	839.2	59
Per cent actually digested....	66.4	-	68.1	56.7	64.4	72.1	68.7
Per cent digested as per calculation	62.7	-	64.3	54.8	59.2	68.6	65.8
SHEEP 3.							
Total fed—same as Sheep 1.							
Amount actually digested....	1,540.7	-	1,488.8	130	403.2	890	65.6
Amount digested as calculated from results with foods fed singly....	1,460.6	-	1,415.1	126.2	374.9	845.4	64.1
Per cent actually digested.........	67.1	-	68.6	59.6	63.1	72.7	73.2
Per cent digested as per calculation	63.6	-	65.1	57.9	58.6	69.4	71.5
Average per ct. actually digested†	66.7	-	68.3	58.1	63.7	72.4	70.9
Average per cent digested as per calculation†	63.1	-	64.7	56.3	58.9	69	68.6

* These coefficients are evidently too high.

† Average to Sheep 2 and 3.

The outcome of these experiments does not give quite so definite testimony as is desirable. In the case of the hay and southern corn silage combination the calculated and the actual digestibility agree very closely, while with the hay and field corn silage the actual digestibility is about 3.5 per cent greater than the calculated. Although this difference is not large, and might occur within the limitations of error with a single experiment, it seems desirable to secure additional evidence before formulating conclusions.

APPENDIX TO DIGESTION EXPERIMENTS.

TABLE XVII.

DIGESTIBILITY OF MIXED HAY.

SHEEP 1.	Dry substance.	Ash.	Organic matter.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
Amount fed in 5 days, 3,000 grs	2,694.1	139.3	2,554.8	200.2	883.3	1,390.2	82.1
Amount excreted in 5 days	1,230	97.8	1,132.2	103.8	452.8	537.9	38.1
Amount digested in 5 days.........	1,464.1	41.5	1,422.6	96.4	430.5	852.3	44.0
Per cent digested..................	54.4	28.8	55.7	48.2	48.7	61.3	57.3
SHEEP 2.							
Amount fed in 5 days, 3,000 grs.....	2,694.1	139.3	2,554.8	200.2	882.3	1,390.2	82.1
Amount excreted in 5 days	1,275.2	100	1,175.2	114.7	450.6	562	47.8
Amount digested	1,418.9	39.3	1,379.6	85.5	431.7	828.2	34.3
Per cent digested..................	52.7	28.2	54	42.7	48.9	59.6	41.8
SHEEP 3.							
Amount fed in 5 days, 3,000 grs	2,694.1	139.3	2,554.8	200.2	882.3	1,390.2	82.1
Amount excreted in 5 days.........	1,238.5	95.7	1,142.8	110.8	454.4	538.8	38.8
Amount digested.....	1,455.6	43.6	1,412.0	89.4	427.9	851.4	43.3
Per cent digested	54.1	31.3	55.3	44.7	48.5	61.2	52.7
Average per cent digested.........	53.7	29.4	55	45.2	48.7	60.7	50.6

TABLE XVIII.

DIGESTIBILITY OF SOUTHERN CORN SILAGE.

SHEEP 1.	Dry matter.	Ash.	Organic substance.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
Amount fed in 5 days 10,000 grs....	1,360	114.9	1,245.1	152.2	418.9	627.2	46.8
Amount excreted in 5 days	482.1	55	427.1	61.2	131.9	218.9	15
Amount digested	877.9	59.9	818	91	287	408.3	31.8
Per cent digested	64.6	52.3	65.7	59.8	68.5	65.1	67.8
SHEEP 2.							
Amount fed in 5 days 12,500 grs ...	1,700	142.6	1,556.3	190.2	523.6	784	58.5
Amount excreted in 5 days	604.5	71.4	533.1	75.3	166.6	272.3	18.9
Amount digested.....	1,095.5	71.2	1,023.2	114.9	357	511.7	39.6
Per cent digested..................	64.5	50	65.8	60.4	68.2	65.3	67.6
SHEEP 3.							
Amount fed in 5 days	1,700	142.6	1,556.3	190.2	523.6	784	58.5
Amount excreted in 5 days........	650.3	76.4	574	76.6	179.3	299.5	18.5
Amount digested	1,049.7	66.2	982.3	113.6	344.3	484.5	40
Per cent digested.........	61.8	46.5	63.1	59.7	65.8	61.8	68.4
Average per cent digested	63.6	49.6	64.8	59.9	67.5	64.1	67.9

TABLE XIX.

DIGESTIBILITY OF MAINE FIELD CORN SILAGE.

SHEEP 1.	Dry matter.	Ash.	Organic substance.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
Amount fed in 5 days, 10,000 grs.. .	2,036	111.8	1,924.2	243.3	444.9	1,114.7	121.3
Amount excreted in 5 days........	506.8	66.1	440.8	76.7	97.6	252.5	13.9
Amount digested	1,530.2	45.7	1,483.4	166.6	347.3	864.2	108.4
Per cent digested..........	75.1	41	77.2	68.5	78.1	77.4	88.5
SHEEP 2.							
Amount fed in 5 days, 10,000 grs....	2,036	111.8	1,924.2	243.3	444.9	1,114.7	121.3
Amount excreted in 5 days........	488.1	67.7	420.5	85.4	92.7	225.2	17.2
Amount digested..	1,547.9	44.1	1,503.7	157.9	352.2	889.5	114.1
Per cent digested..................	76	39.4	78.2	64.9	79.2	79.8	85.8
SHEEP 3.							
Amount fed in 5 days, 10,000 grs....	2,036	111.8	1,924.2	243.3	444.9	1,114.7	121.3
Amount excreted in 5 days........	485.9	68.6	417.3	75.7	97	229.1	15.5
Amount digested	1,550.1	43.2	1,506.9	167.6	347.9	885.6	105.8
Per cent digested...........	76.2	39	78.4	68.9	78.2	79.5	87.2
	75.7	39.8	77.9	67.4	78.5	78.9	87.1

TABLE XX.

DIGESTIBILITY OF HAY AND SOUTHERN CORN SILAGE.

SHEEP 1.	Dry matter.	Ash.	Organic substance.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
Hay fed in 5 days, 1,500 grs..........	1,314	70.5	1,243.4	98.8	424.3	677.6	42.7
Silage fed in 5 days, 3,000 grs........	691	56.9	634.0	76.8	210.7	314.5	32
Total fed.	2,005	127.4	1,877.4	175.6	635.0	992.1	74.7
Excreted in 5 days..................	899	88.4	810.6	86.2	290.7	403.8	29.8
Amount digested	1,106	39.0	1,066.8	89.4	344.3	588.3	44.9
Per cent digested....................	55.1	30.6	56.8	50.9	54.2	59.3	59
SHEEP 2.							
Hay fed in 5 days, 1,500 grs..........	1,314	70.5	1,243.4	98.8	424.3	677.6	42.7
Silage fed in 5 days, 6,250 grs........	863.5	71.1	792.3	96	263.3	393	39.9
Total fed..........	2,177.5	141.6	2,035.7	194.8	687.6	1,070.6	82.6
Excreted in 5 days..........	895.1	86.4	808.7	94.6	287.3	397.3	29.4
Amount digested	1,282.4	55.2	1,227.0	100.2	400.3	673.3	53.2
Per cent digested....................	58.9	38.4	60.3	52	56	62.9	64.4
SHEEP 3.							
Total fed......	2,177.5	141.6	2,035.7	194.8	687.6	1,070.6	82.6
Excreted in 5 days..................	935.8	88.6	847.2	94.8	312.8	410.7	28.9
Amount digested	1,241.7	53.0	1,188.5	100.0	374.8	659.9	53.7
Per cent digested....................	57	37.4	58.4	51.4	53.9	61.7	65

TABLE XXI.

DIGESTIBILITY OF HAY AND FIELD CORN SILAGE.

SHEEP 1.	Dry matter.	Ash.	Organic substance.	Protein.	Fiber.	Nitrogen free-extract.	Fat.
Hay fed in 5 days, 1,500 grs	1,309.5	68.1	1,241.4	99.5	421.4	679.6	40.8
Silage fed in 5 days, 5,000 grs	987.5	57.7	929.7	118.6	218.1	544.1	48.9
Total fed	2,297	115.8	2,171.1	218.1	639.5	1,223.7	89.7
Amount excreted in 5 days	606.5	58.8	547.7	68.5	190.3	271.4	17.6
Amount digested	1,690.5	57.0	1,623.4	149.6	449.2	952.3	72.1
Per cent digested	73.6	49	74.8	68.6	70.3	77.8	80.4
SHEEP 2.							
Total fed in 5 days	2,297	115.8	2,171.1	218.1	639.5	1,223.7	89.7
Excreted in 5 days	771.8	79.6	692.1	94.5	227.7	341.8	28.1
Amount digested	1,525.2	36.2	1,479	123.6	411.8	881.9	61.6
Per cent digested	66.4	-	68.1	56.7	64.4	72.1	68.7
SHEEP 3.							
Total fed in 5 days	2,297	115.8	2,171.1				
Excreted in 5 days	756.3	74	682.3				
Amount digested	1,540.7	41.8	1,488.8				
Per cent digested	67.1	-	68.6				

FEEDING EXPERIMENTS.

LARGE OR SMALL HAY RATION.

One of the subjects that have received more or less attention at farmers' institutes in the past is the amount of hay that can be profitably fed to milch cows. It has been claimed on the part of some of our prominent farmers that if hay is the only coarse food that a cow of ordinary size is eating, fifteen pounds is as much as she will consume with profit when combined with a fairly liberal grain ration.

Some have gone so far as to claim that the yield of milk and butter from the fifteen pounds of hay has, in their experience, been as large as from twenty pounds, the grain ration being the same in both cases, and have explained such a result on the ground that with the large hay ration the animal fails to digest her food properly and so wastes it. Others disagree with this practice and profess not to be able to keep their cows up to a generous flow of milk and a thrifty condition with so small an amount of hay, unless they give an increased grain ration.

In the winter and spring of 1894 the Station undertook to test this matter by an experiment. Briefly stated, the plan of the experiment was this: Three cows were fed during three periods of four weeks each. In the first and last periods the animals received five pounds of hay as a noon feed, but in the second period this was taken away.

A record of the food consumed, the weight of the cows and the yield and composition of the milk was made. The data obtained do not furnish so decisive testimony either way as could be desired, although the figures here presented, accompanied by the observations that were made concerning the general appearance and condition of the animal, give to the experimenter a good basis for an opinion.

The daily rations for the several periods were as follows:*

13 pounds hay.
25 pounds silage.
s cottonseed meal.
n and cob meal.
ge.
tonseed meal.
n meal.

Tables XXII and XXIII which appear, by mistake, on page 45 should follow Table XXI on page 44.

tion during the first period only that she ate oughout.

Second Period 28 days. Cows 1 and 2.	First half	8 pounds hay. 25 pounds silage. 2 pounds cottonseed meal. 5 pounds corn meal.
	Second half	8 pounds hay. 25 pounds silage. 2 pounds cottonseed meal. 5 pounds corn and cob meal.

The cow Agnes received the same ration during the second period only that she ate ten pounds hay throughout.

Third Period 28 days.	All cows received in this period the same rations as during the first.

The corn meal and corn and cob meal were from the same lot of Maine grown corn.

A sample of the milk of each milking was taken during the last five days of each half period, and the following is the composition for each five days' test.

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* For composition of foods see report of L. H. Merrill.

COMPOSITION OF MILK.

PERIOD 1.

	Cow 1.		Cow 2.		Agnes.	
January 30, morning	11.87	3.25	13.08	4.10	13.48	4.30
night	13.29	4.50	13.23	4.45	13.81	4.85
January 31, morning	12.75	3.55	12.79	3.85	13.95	4.70
night	12.53	3.95	12.87	4.15	13.56	4.45
February 1, morning	12.14	3.25	12.49	3.85	13.82	4.55
night	12.86	4.15	13.57	4.80	13.60	4.80
February 2, morning	12.20	3.40	12.42	3.95	13.79	4.70
night	12.33	3.95	13.39	4.25	13.43	4.30
February 3, morning	11.88	3.10	12.60	3.90	13.75	4.35
night	12.61	3.85	13.21	4.15	13.69	4.40
	12.45	3.69	12.56	4.14	14.19	4.54
February 13, morning	12.08	3.50	12.95	3.90	13.87	4.70
night	12.69	3.80	13.36	4.05	13.72	4.30
February 14, morning	12.35	3.15	13.37	4.00	14.07	4.35
night	13.39	4.30	13.40	4.00	14.69	5.10
February 15, morning	12.28	3.30	13.12	4.15	14.13	4.75
night	12.25	3.75	12.98	4.15	13.02	4.00
February 16, morning	11.94	3.10	12.84	3.85	13.80	4.55
night	12.50	3.85	12.99	4.05	13.63	4.45
February 17, morning	11.91	3.10	12.93	3.90	14.44	5.00
night	12.44	3.95	12.97	4.00	13.39	4.40
	12.38	3.57	13.13	4.00	13.88	4.56

PERIOD 2.

	Cow 1.		Cow 2.		Agnes.	
February 27, morning	12.01	3.50	12.75	3.85	13.10	4.05
night	12.78	4.00	13.36	4.35	13.22	4.50
February 28, morning	12.27	3.35	13.08	3.75	13.70	4.25
night	12.67	3.95	12.67	4.10	13.99	5.15
March 1, morning	12.58	3.75	12.81	4.00	14.12	5.10
night	12.80	4.15	13.26	4.35	13.49	4.65
March 2, morning	12.27	3.40	12.71	3.70	13.91	4.80
night	12.98	4.45	14.17	4.85	13.49	4.55
March 3, morning	12.18	3.40	13.54	4.15	13.80	4.70
night	12.73	4.20	13.01	4.35	13.65	4.55
	12.53	3.81	13.13	4.14	13.65	4.63

COMPOSITION OF MILK—CONCLUDED.

PERIOD 2—Concluded.

	Cow 1.		Cow 2.		Agnes.	
March 13, morning	11.39	3.10	12.87	3.95	13.62	4.95
night	12.22	3.90	13.26	4.50	13.43	4.65
March 14, morning	11.93	3.25	12.52	3.55	13.38	4.30
night	12.50	4.30	12.69	4.55	14.31	5.45
March 15, morning	12.32	3.50	13.09	4.00	13.96	4.75
night	13.39	4.65	13.07	4.25	13.39	4.65
March 16, morning	11.57	3.10	12.90	3.80	13.48	4.30
night	12.52	4.05	13.24	4.30	13.99	4.60
March 17, morning	12.09	3.25	12.76	3.60	14.30	4.65
night	12.69	4.05	12.82	4.15	13.10	4.45
	12.26	3.71	12.92	4.06	13.70	4.67

PERIOD 3.

	Cow 1.		Cow 2.		Agnes.	
March 27, morning	12.11	3.20	13.00	4.05	14.29	4.90
night	13.30	4.60	13.12	4.40	13.88	5.00
March 28, morning	12.64	3.60	12.85	3.80	14.64	5.25
night	12.61	4.30	13.35	4.30	14.39	4.80
March 29, morning	12.11	3.05	13.20	4.00	14.73	5.15
night	13.75	4.70	13.61	4.50	13.99	4.70
March 30, morning	12.50	3.65	12.93	3.90	14.28	4.85
night	13.20	4.80	13.13	4.25	13.92	5.10
March 31, morning	11.75	3.20	13.13	4.10	14.20	5.25
night	14.09	5.25	14.04	4.80	14.05	4.95
	12.81	4.03	13.24	4.21	14.24	4.99
April 10, morning	12.33	3.70	13.33	4.15	14.85	5.80
night	13.59	5.10	13.20	4.20	13.91	4.70
April 11, lost.						
April 12, morning	12.17	3.40	13.19	4.00	14.56	5.45
night	14.12	5.35	13.06	4.55	13.19	4.05
April 13, morning	12.35	3.45	13.05	4.45	13.99	4.65
night	13.79	4.75	13.73	4.40	14.39	5.00
April 14, morning	12.75	3.60	13.33	4.05	15.35	5.85
night	14.48	5.55	14.07	4.65	13.71	4.40
	13.20	4.36	13.37	4.31	14.24	4.99

TABLE XXII.

COMPOSITION OF FOODS AS FED IN DIGESTION EXPERIMENTS.

	Moisture as fed.	In 100 parts water-free substance.				
		Ash.	Protein.	Fiber.	Nitrogen free-extract.	Fats.
CCLXIII Hay—fed alone..............	12.1	5.17	7.43	32.75	51.60	3.05
CCLXIV Hay—fed with So. Corn Silage ..	12.6	5.37	7.52	32.29	51.57	3.25
CCLXV Hay—fed with Field Corn Silage..	12.7	5.20	7.61	32.18	51.88	3.13
CCLXVI So. Corn Silage—fed alone	86.4	8.44	11.19	30.77	46.16	3.44
CCLXVII So. Corn Silage—fed with hay...	86.18	8.24	11.13	30.56	45.44	4.63
CCLVIII Field Corn Silage—fed with hay,	80.25	5.87	12.01	22.10	55 07	4.95
CCLXXXI Field Corn Silage—fed alone...	79.64	5.49	11.96	21.86	54.73	5.96

TABLE XXIII.

WEIGHTS OF AIR-DRY EXCREMENT.*

	Sheep 1.	Sheep 3.	Sheep 4.
	grams.	grams.	grams.
Hay alone..............................	1,302	1,350	1,311
Southern corn silage—fed alone.....	510	637.5	685
Southern corn silage and hay.....	952	946	965
Field corn silage—fed alone..................................	531	507.8	504.4
Field corn silage and hay......................	637	809	788

* For analyses see report of L. H. Merrill.

COMPOSITION OF THE MILK.

AVERAGES FOR EACH FIVE DAYS.

		Cow 1.		Cow 2.		Agnes.	
		Total solids.	Fat.	Total solids.	Fat.	Total solids.	Fat.
Period 1	First half	12.45	3.69	12.86	4.14	14.19	4.54
	Second half...........	12.38	3.57	13.13	4.00	13.88	4.56
Period 2	First half	12.58	3.81	13.13	4.14	13.65	4.63
	Second half...........	12.26	3.71	12.92	4.06	13.70	4.67
Period 3	First half	12.81	4.03	13.24	4.21	14.24	4.90
	Second half...........	13.2	4.36	13.37	4.31	14.24	4.90

FOOD CONSUMED, MILK YIELD, WEIGHT OF COWS AND COMPOSITION OF MILK.

FIRST PERIOD—28 days.		Hay eaten—pounds.	Silage eaten—pounds.	Grain eaten—pounds.	Live weight at end of period—pounds.	Yield of milk—pounds.	COMPOSITION OF MILK.	
							Per cent solids.	Per cent fat.
First half, 14 days,	Cow 1,	182	350	98	727	407	12.44	3.69
	Cow 2,	182	350	98	753	309	12.86	4.14
	Agnes,	210	350	98	847	320	14.19	4.54
Milk yield first half		....	....	....	....	1,036		
Second half, 14 days	Cow 1,	182	350	98	727	399	12.38	3.57
	Cow 2,	182	350	98	763	338	13.13	4.00
	Agnes,	210	350	98	850	319	13.88	4.56
Milk yield second half......		... ...	....	....	....	1,056		
Total milk yield.........		....	....	....	....	2,092		
SECOND PERIOD—28 days.								
First half, 14 days,	Cow 1,	112	350	98	674	381	12.52	3.81
	Cow 2,	112	350	98	720	323	13.13	4.14
	Agnes,	140	350	98	798	305	13.64	4.63
Milk yield first half		....	....	....	....	1,009		
Second half, 14 days	Cow 1,	112	350	98	670	334	12.26	3.71
	Cow 2,	112	350	98	732	295	12.92	4.06
	Agnes,	140	350	98	814	278	13.70	4.67
Milk yield second half......		....	....	....	....	907		
Total milk yield....		....	... .	....	....	1,916		
THIRD PERIOD—28 days.								
First half, 14 days,	Cow 1,	182	350	98	716	293	12.80	4.03
	Cow 2,	182	350	98	770	288	13.24	4.21
	Agnes,	210	350	98	852	237	14.24	5.00
Milk yield first half..... ...		... .	....	....	....	818		
Second half, 14 days	Cow 1,	182	350	98	725	317	13.20	4.36
	Cow 2,	182	350	98	771	310	13.37	4.31
	Agnes,	210	350	98	840	268	14.24	4.99
Milk yield second half......		.... . .	....	....	....	895		
Total milk yield........		....	... ...	... .	....	1,713		

The testimony of this experiment, as gained from observation of the animals and a study of the figures given in this connection, is unfavorable to the smaller ration of hay.

The withdrawal of the noon feed of five pounds of hay resulted in (1) a diminished flow of milk, (2) a loss of weight of the animals and (3) an appearance of unthriftiness in the cows.

To be sure the cows gave less milk during the third period, after the larger ration was restored than in the previous period on a smaller hay ration, but it was easy for the experimenter to see that the animals were using their food to recover from the depressing effect of an insufficient food supply. It is also noteworthy that during the last half of the third period the cows had not only recovered their loss of weight but had begun to gain in milk yield. The writer cannot resist the temptation to call the attention of those who believe that the ration largely controls the quality of the milk to the fact that although the cows lost flesh and diminished greatly in their product, the quality of the milk seems not to have been influenced.

Attention is also directed to the great variations that occurred from day to day in the quality of the milk, although no changes occurred in the food.

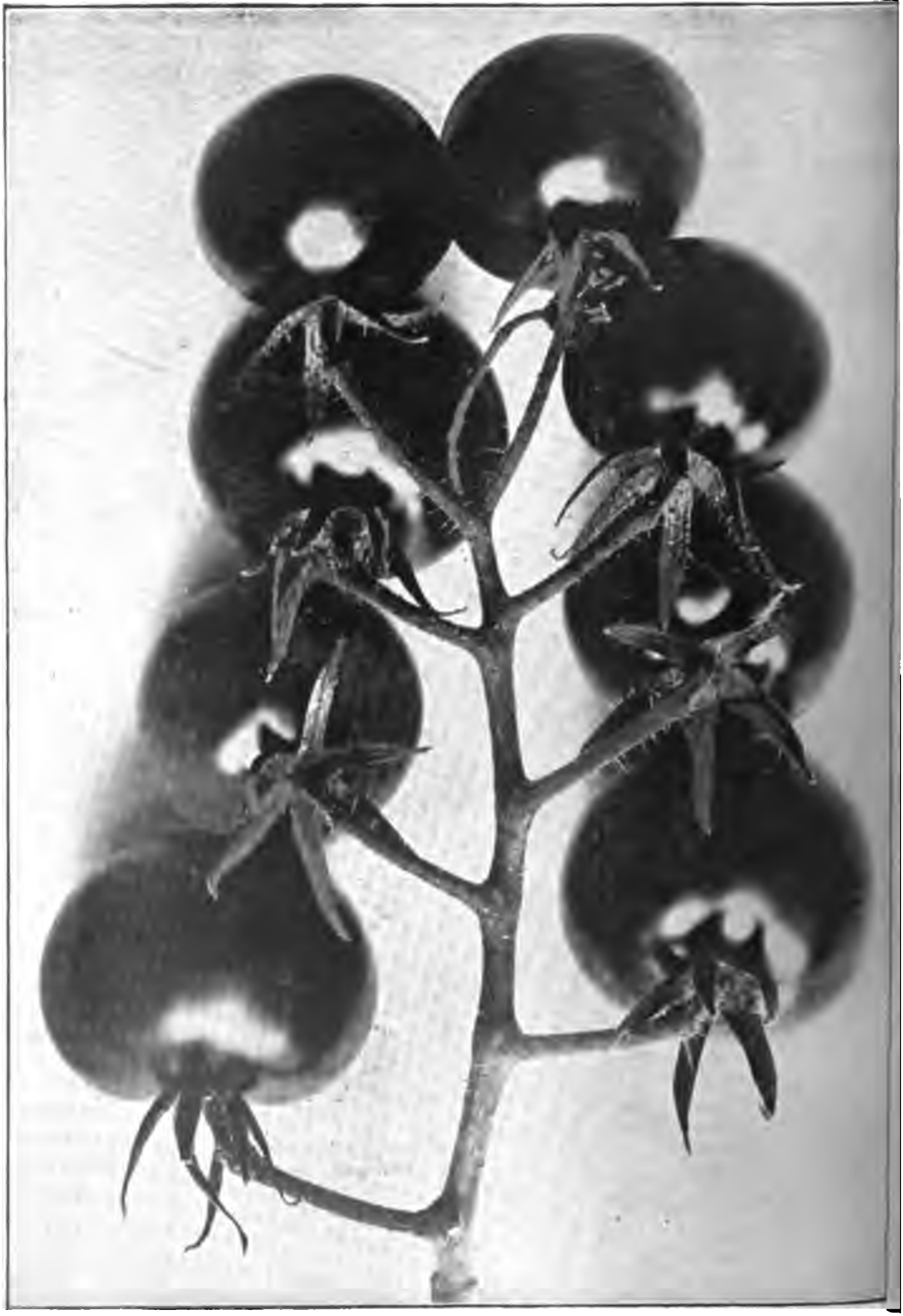

PLATE I. A TOMATO HYBRID. (NATURAL SIZE.)

REPORT OF THE HORTICULTURIST.

HORTICULTURAL NOTES.

W. M. MUNSON, Horticulturist. H. P. GOULD, Assistant.

It has been the policy of the Horticultural Division from the outset to conduct work which should be of permanent value and to continue every investigation through a series of years. Each year's experience gives additional facts for the direction of investigation; the field is ever widening, therefore we have not completed any line of investigation and do not expect to do so.

In addition to our perennial studies it is our purpose to conduct a certain amount of work which shall have an immediate practical value to the farmers of the State. This work is mainly in determining the characteristics of different fruits and vegetables offered for sale, in applying approved methods of culture and in combating the insect and fungous pests of orchard and garden. The interest in this work on the part of the gardeners and fruit growers of the State, as evinced by the increasing volume of our correspondence and the demand for bulletins would seem to justify its continuance, but we would not lose sight of the main point, viz.: that principles are of more importance than isolated facts.

I—NOTES OF POTATOES.

The Rural New Yorker Trench System.

In 1893 a comparison was made between the ordinary furrow culture of potatoes and the so-called *Rural New Yorker Trench System.* From this work we concluded: "That it is questionable whether the results obtained will justify the extra labor involved in practicing the trench system. * * * Duplicate lots in every instance produced contradictory results."* This conclusion was afterwards called in question on the ground of too deep planting, though the criticism was without reason.

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*Rep. Me. Exp. Sta. 1893. p. 124.

During the past season the work was very carefully repeated on a more extensive scale. The land selected for the purpose was a strong clay loam, naturally moist, but thoroughly underdrained. The land was divided into two plots of one-twentieth acre each.

The variety used in this test was Early Rose. On each plot sixty pounds of a complete fertilizer were applied—broadcast for the common system; in the trench with the other.

The two plots were plowed and harrowed alike. One was then furrowed about four inches deep, and planted in the ordinary manner, the fertilizer applied on the surface.

On the other plot furrows eight inches deep were made. These were then pulverized to a depth of fourteen inches. They were then filled to six inches, after which the fertilizer was distributed in the trenches and covered with two inches of soil. The tubers were then planted in the same manner as on the other plot. The two plots were treated alike during the remainder of the season.

The results obtained from the two lots are shown in a table.

TABLE I.

Treatment.	Whole number of tubers.	Number of marketable tubers.	Weight of marketable tubers—pounds.	Number of small tubers.	Weight of small tubers.
EARLY ROSE.					
Trench	**3,662**	2,077	**599.75**	1,585	**95.25**
Furrow	**3,311**	2,284	**682.25**	1,027	**64.00**

The total number of tubers was greater from the trenches, but the gain was wholly in those which were small and unmarketable. The average size of individual tubers from the two plots was not essentially different, but as seen in column four the number of salable tubers was much larger from the furrows,—there being a difference of 82.5 pounds on the plot. The tops remained green several days longer on the plot which was furrowed than on the other and this may in part account for the relatively large number of salable tubers.

The actual cost of labor in preparing and planting the two plots, after plowing and harrowing, was, for the trench system sixty cents and for the other thirty-two and one-half cents, or a difference of twenty-seven and one-half cents.

Reducing the results above detailed to the basis of one acre we have $5.50 as the increased cost of planting by the trench system with nothing to show for it,—on the contrary with an actual difference of 27.5 bushels in favor of the ordinary method.

We are thus led to the same conclusion as last year, viz.: Results do not justify the extra labor involved in the trench system.

II—NOTES OF CORN.

Except in our general studies of plant variation, corn has not received marked attention at this station. During the past year, however, several varieties were grown, and some notes concerning their behavior are given. The table indicates in the most concise way the more important points of general interest. All varieties were planted May 27th.

TABLE II.

VARIETY.	Date of first appearance of tassels.	Date of first appearance of silks.	Date of edible maturity.	Number of days from planting to edible maturity.	Relative yield—scale of 100.	Average height of stalks in feet.
Crosby	July 19,	Aug. 7,	Sept. 1,	**97**	60	6.5
Dreer's Extra Early	July 17,	July 24,	Aug. 15,	**80**	71	5.0
Early Cory	July 11,	July 24,	Aug. 14,	**79**	63	5.0
Early Minnesota	July 14,	July 27,	Aug. 25,	**90**	85	5.5
Marblehead	July 17,	July 24,	Aug. 15,	**80**	66	5.0
Moore's Concord	July 27,	Aug. 7,	Sept. 8,	**104**	58	6.5
Narragansett	July 14,	Aug. 2,	Aug. 25,	**90**	85	5.5
Nonesuch	July 27,	Aug. 9,	Sept. 19,	**115**	42	5.5
Perry's Hybrid	July 17,	July 31,	Aug. 28,	**93**	77	6.5
Stabler Pedigree	July 27,	Aug. 11,	Sept. 19,	**115**	52	7.0
Country Gentleman	Aug. 4,	Aug. 25,	Did not reach edible maturity.	....	....	5.5
Egyptian	July 31,	Aug. 19,		....	....	6.0
Ne Plus Ultra	Aug. 2,	Aug. 22,		....	....	6.0
Ruby	Aug. 4,	Aug. 24,		....	....	6.0
Stowell Evergreen	July 31,	Aug. 19,		....	....	7.0

As seen in Column 5, the varieties in the order of maturity were as follows: Cory, Dreer, Marblehead, Early Minnesota, Narragansett, Perry's Hybrid, Crosby, Moore's Concord, Nonesuch and Stabler. For the average home garden we would select from this list Cory or Dreer for early use and Crosby or Perry's Hybrid for medium and late. The last named sort has been one of our favorites for general crop. As an early sort Dreer was somewhat superior to Cory in that the ears were larger and it was slightly more productive.

Column 6 represents the relative yield; the basis being the average number of ears per plant.

III—Notes of Tomatoes.

1. Historical—Our garden varieties of tomatoes belong to two distinct species,—*Lycopersicum pimpinellifolium*, Dunal, and *Lycopersicum esculentum*, Miller. The former is represented in the garden by the "Currant" or "German Raisin." This species is found wild in Peru and Brazil, but little is known of its history. It has not been modified by domestication and probably has not been long under cultivation. The chief value of this species aside from its use as an ornamental plant and to a limited extent for preserves, is in the breeding of new types, as suggested in previous reports.*

Lycopersicum esculentum, the ordinary tomato, is undoubtedly a native of Peru, but is spontaneous or indigenous throughout Mexico and as far north as Texas and California in a form closely approaching the cherry tomato of the gardens. So far as we know, it was first cultivated in the south of Europe. It is mentioned as early as 1561, while in 1583 the "fruit was eaten upon the continent dressed with pepper, salt and oil."† It was grown in England in 1597‡ but for many years was used only for ornament. Even so late as 1819 only four varieties are named. §

Our own country was even later than England in beginning the general culture of the tomato. The fruit is said to have been introduced into Philadelphia by a French refugee from St. Domingo in 1798,§§ and in 1806 McMahon writes: "The tomato is much

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*Report Maine Experiment Station, 1892. 68.

†Dodonæi, Stirp, Hist., 455.

‡Gerarde, Herballe, 275.

§Trans. London, Hort. Society, III, 347.

§§Manning, Hist. Mass. Hort. Soc. 40.

PLATE II. FORCING TOMATOES UNDER GLASS.

cultivated for its fruit in soups and sauces . . . and is also stewed and dressed in various ways and very much admired."[*] It was introduced into Salem, Mass., about 1802 by an Italian painter Comé, "but he found it difficult to persuade the people even to taste the fruit."[†] The general culture of the tomato for market began about 1829.

The history of the introduction of our common varieties is a record of gradual change from the angular sorts of the Orangefield and Hundred Day type to the smooth apple-shaped type of to-day. The old Large Red of the earlier catalogues was followed in 1862 by Fiji Island and in 1864 by the Cook's Favorite. In 1866, Tilden appeared and then in rapid succession Maupay, Keye's Extra Early, Boston Market, General Grant, Trophy and Paragon.

Paragon was the first of the round or apple-shaped varieties to attain prominence, and its introduction gave a great impetus to the culture of the tomato as a field crop. It was a triumph for the application of correct principles of selection, for in the production of this variety the habit of a whole plant rather than the character of an individual fruit was considered.

In 1880, Perfection appeared and during the next decade, Favorite, Beauty, Dwarf Champion, Lorillard, Ignotum, and a host of similar excellent varieties have been put forward, till it would almost seem that further improvement may not be expected.

II—Forcing Tomatoes in Winter.

I have repeatedly called attention to the importance of the winter forcing of fruits and vegetables in supplying a growing demand. Each season during the past four years, we have grown with uniform success many of the more promising varieties, and have attempted to secure new strains and hybrids which would be of special value for forcing. Methods of culture have also received attention and the deductions here given are based on the most careful study of the plants in all of their relations.

General Cultural Notes.—Successful tomato culture under glass depends fully as much on the man in charge as on conditions. Eternal vigilance and the exercise of good judgment on the part of the grower are more essential than strict adherence to set rules. Strong bottom heat, plenty of light and a large volume of pure air are important conditions and are best secured in a large, well ventilated house. Bottom heat is not absolutely essential to success, but the crop matures much more quickly if given this condition. The house in which all of our work with tomatoes has been conducted is twenty by fifty feet and about eleven feet high at the ridge. The central bed is supplied with six two-inch hot water pipes; the flow being carried overhead to the further end of the house. The accompanying diagram—Fig. 1—represents a cross-section of this house showing the benches and the relative location of the hot-water pipes.

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[*] McMahon, Gard. Calendar. 319.

[†] Felt, Annals of Salem II, 631; cited by Manning, Hist. Mass. Hort. Soc. 40.

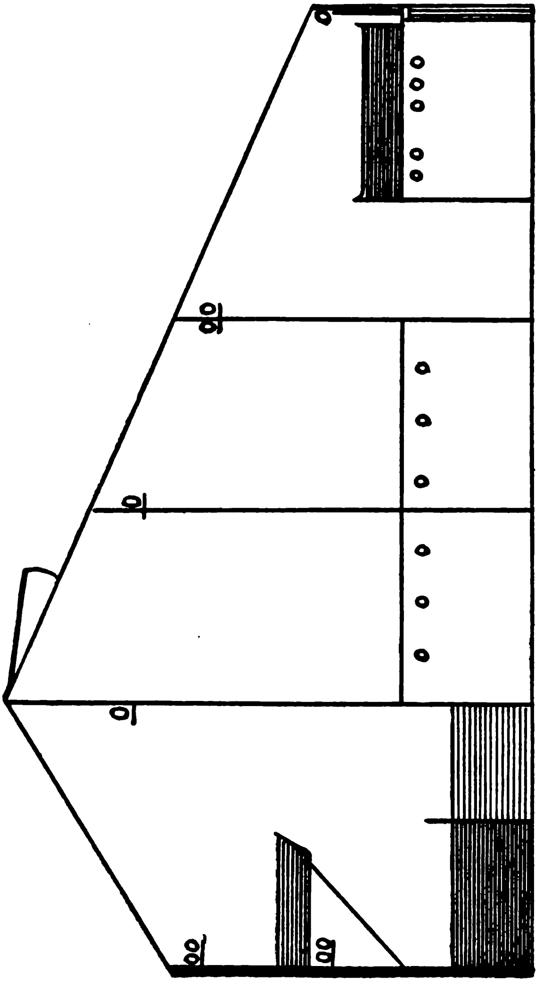

FIG. 1—CROSS SECTION OF FORCING HOUSE.

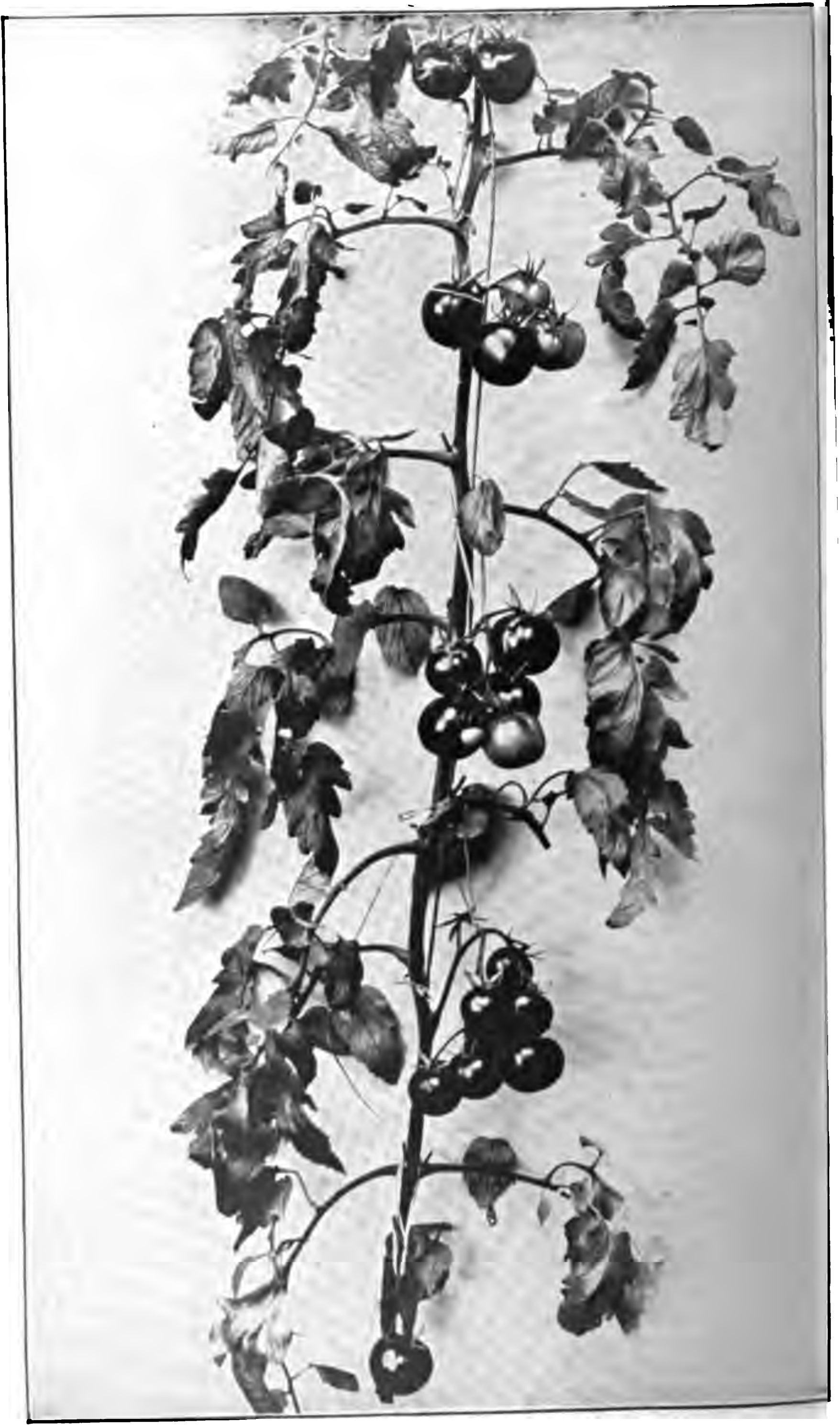

PLATE III. SINGLE STEM TRAINING (CHEMIN MARKET.)

To make the best use of the house two crops should be grown during the season. This will bring each crop on at a season when the expense of heating during a part of the time will be slight. Plants for the first crop should be started as early as the first of August, the middle of July being none too early if the bulk of the crop is desired for the holidays. In case two or more houses are available it is well to make a second sowing in about three weeks to give a succession. For the second crop seed should be sown about the first of November.

The plants are treated in every way as for out-door culture till handled the last time. For the final receptacle for fruiting we have generally used boxes eighteen inches square and one foot deep. In the bottom place a layer of about an inch of charcoal, potsherds or "clinkers" from the furnace; then fill to within two or three inches of the top with prepared soil, consisting of three parts good garden loam and one part well-rotted stable manure. Each box will hold four plants, and the check caused by the partial confinement of the roots seems to be of value in hastening maturity. This point is discussed in another connection (see page 57-59).

We have usually found the best returns to follow when the plants were trained to a single stem, as shown in Plate III.

.Flax cords about the size of wool twine are fastened to the corners of the boxes and attached above to wires running lengthwise of the building on the rafters or sash-bars. The plants are secured loosely to this support by means of bast or raffia. All side shoots should be removed as soon as they appear. When the plants are about five feet high, or when about four clusters of fruit have set, the terminal buds should be pinched off. The vitality of the plant will then be expended in the development of the fruit.

As the fruit sets, the clusters should be supported by means of a small cord or piece of raffia passing around the main stem above a leaf, thus forming a sling. At this time, too, it is well to stir the surface of the soil and work in a quantity of well-rotted manure, or to give frequent applications of liquid manure.

The temperature of the house should be as nearly uniform as possible. We usually prefer about 60° at night and 70° in dark weather, but on bright sunny days the mercury may run up to 80° or higher. If possible, avoid cold draughts and sudden changes of temperature.

Until the plants begin to blossom, the atmosphere of the house should be kept moist and the soil, though not saturated, should never become very dry. Our practice, after the plants are removed to the fruiting boxes, is to water thoroughly about three time a week—less frequently in dark weather. On all bright days the walks and tables are thoroughly sprayed.

Some method of artificial pollination is usually found necessary. The best time to pollinate (fertilize) is about noon on bright days when the air in the house is dry. Tomato flowers are highly self-fertile, and the operation of pollinating consists simply in giving each plant two or three sharp taps with a padded stick. Some consider it necessary to attend to each individual flower, but we have always found the other method satisfactory.

A Comparison of Box Culture with Open Beds.—The writer has frequently expressed a preference for eighteen inch boxes in forcing tomatoes, on the ground that a reasonable confinement of the roots would tend to induce fruitfulness. Some extensive growers, however, maintain that the open bed or border is preferable; though all agree that bottom heat is always to be desired

Each year a dozen or more plants of each of several varieties have been grown in boxes as described on page 57, while duplicate lots have been grown in open beds. These beds were two and one-half to three feet wide and eight inches deep. They were built across the central bench and thus received the same bottom heat as the boxes. The following table represents in detail the results obtained:

TABLE III.

VARIETY.	FIRST CROP.				SECOND CROP.			
	First ripe fruit.	Number fruits per plant.	Weight of fruit per plant—pounds.	Average weight of fruits—ounces.	First ripe fruit.	Number fruits per plant.	Weight of fruit per plant—pounds.	Average weight of fruits—ounces.
1892-3.								
GOLDEN QUEEN.								
Box	....	.....	.....	.....	April 24,	7	1.36	3.1
Bed	....	.....	.....	.....	April 25,	7	.9	2.1
ITHACA.								
Box	Nov. 19,	9	1.4	2.5	April 11,	10	1.66	2.6
Bed	Nov. 23,	9.5	1.1	1.8	April 18,	8	.92	1.8
LONG KEEPER.								
Box	....	.....	.....	.....	April 17,	13	2.12	2 6
Bed	....	.....	.....	.....	May 6,	7.7	.8	1.6
*LORILLARD.								
Box	Nov. 21,	9.3	1.22	2.2	Nov. 21,	8.2	1.6	3.1
Bed	Nov. 23,	10.3	1.00	1.6	Nov. 23,	7.0	.95	2.1
1893-4.								
GOLDEN QUEEN.								
Box	Dec. 23,	12.5	2.32	2.97				
Bed	Dec. 16,	11	1.72	2.27				
ITHACA.								
Box	Nov. 9,	15.2	2.19	2.3	May 17,	10.9	1.69	2.47
Bed	Nov. 9,	16	2.25	2.25	May 16,	11.6	1.77	2.44
LONG KEEPER.								
Box	....	.....	.....	.....	Dec. 25,	8.8	1.9	3.44
Bed	....	.....	.....	.....	Dec. 9,	8.2	1.57	3.05
LORILLARD.								
Box	Dec. 16,	17.0	1.81	1.70				
Bed	Dec. 29,	8.7	1.28	2.34				

*Duplicate lots grown for first crop.

It will be observed that in almost every instance the better results were obtained from the boxes. With one or two exceptions, the first fruits were matured from one to thirteen days earlier; the weight of the crop was greater; and the individual fruits averaged larger.

The average results for the whole time may be summarized as follows:

TABLE IV.

	Number fruits per plant.	Weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.
GOLDEN QUEEN.			
Box	9.8	1.84	3.0
Bed	9.0	1.31	2.2
ITHACA.			
Box	11.3	1.73	2.5
Bed	10.3	1.51	2.1
LONG KEEPER.			
Box	10.9	2.01	3.0
Bed	8.9	1.19	2.3
LORILLARD.			
Box	11.5	1.54	2.3
Bed	8.7	1.08	2.0

A Comparison of Plants from House and Field Grown Seed.—Attention has previously been called to the possible importance of conditions of growth of the seed in accounting for variation in the character of succeeding generations. It has seemed "possible that by forcing plants to early development in the house and by limiting the amount of fruit borne, a strain of unusual vigor may be produced."[*] With a view to throwing light on this subject several varieties have been grown under glass continuously and compared with the same sorts from seed matured in the open air each year, through succeeding generations.

The results are shown in Table III.

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[*] Rep. Maine Exp. Sta. 1893, 116.

VARIETY.	SECOND CROP 1892-3.			FIRST CROP 1893-4.		
	Average number fruits per plant.	Average weight of product—pounds.	Average weight of individual fruits—ounces.	Average number fruits per plant.	Average weight of product—pounds.	Average weight of individual fruits—ounces.
GOLDEN QUEEN.						
House	....	....	....	14	2.23	3.08
Field	....	....	....	13	2.32	2.97
ITHACA.						
House	5	.87	2.6	11	1.68	2.43
Field	10	1.66	2.6	22	2.45	1.74
LORILLARD.						
House	8	1.46	3.1	19	2.42	2.0
Field	9	1.30	2.4	17	1.81	1.7

VARIETY.	SECOND CROP 1893-4.			FIRST CROP 1894-5.		
	Average number fruits per plant.	Average weight of product—pounds.	Average weight of individual fruits—ounces.	Average number fruits per plant.	Average weight of product—pounds.	Average weight of individual fruits—ounces.
GOLDEN QUEEN.						
House	13	2.9	3.52	10	1.2	1.90
Field	14	3.0	3.46	12	1.1	1.53
ITHACA.						
House						
Field						
LORILLARD.						
House	13	3.2	3.83	11	1.3	2.1
Field	11	2.4	3.57	11	1.1	1.7

It will be observed that with the Lorillard, the average product per plant was always greater from the strain grown in the house, also that the individual fruits were larger. Ithaca, on the other hand, gave almost opposite results; while Golden Queen has from the first shown practically no difference. Unfortunately, before the above data were compiled, it was found necessary to drop one variety because of insufficient space. From the figures given, however, it would seem that there may be distinct varietal differences with reference to the point in question.

The Relative Merits of Different Varieties for Forcing:—Some varieties seem specially adapted for culture under glass, while others fail to give satisfactory results. Why this is so we do not know; but for the purpose of determining the most promising, we have grown several of the best known varieties for several seasons. Naturally, as the days grow longer in April and May the fruit will be of larger size and the product per plant will be greater than is the case with the first crop—in January and February. The figures given below—table VI—represent the average results obtained including both crops for several seasons.

Several other varieties—including Ignotum, Perfection, Peach, Prelude, Dwarf Champion, etc.—have been grown, but those named in the table have proved most satisfactory.

TABLE VI.

VARIETY.	Average number fruits per plant.	Average weight of product—pounds.	Average weight of individual fruits—ounces.
Chemin Market	12	2.29	3.0
Golden Queen	12	2.22	3.8
Ithaca	11	1.69	2.5
Long Keeper	10	1.86	3.0
Lorillard	13	2.05	2.7
Optimus	13	1.96	2.5

The ideal tomato for forcing should be of medium size—about two and one-half ounces preferred—and should be uniform, smooth, regular, and of firm texture. All things considered, Lorillard answers these requirements more completely than any other sort we have grown; though Optimus has usually done well. Chemin Market is very attractive in appearance, and is of good size, but it lacks solidity. Figures 2 and 3 represent respectively, extremes of solidity to be attained and avoided in a forcing tomato.

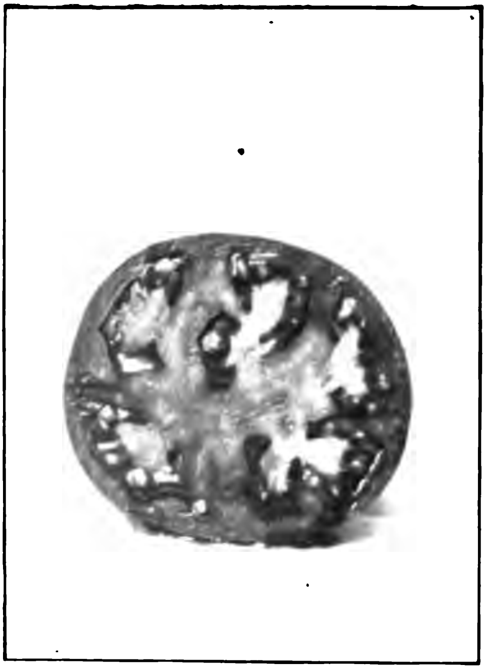


FIG. 2. IGNOTUM.

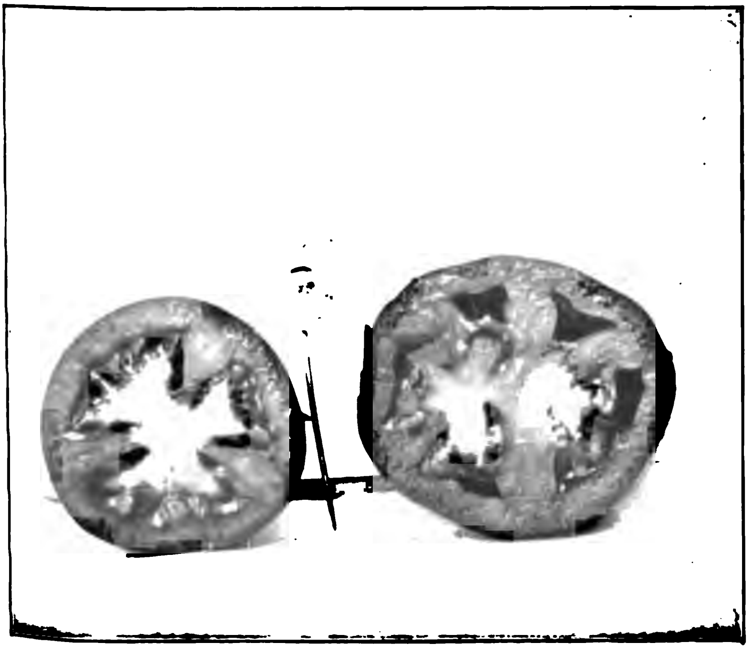


PLATE III. FIG. 3. CHEMIN MARKET.

No collection is complete without a few plants of Golden Queen. This is specially valuable for the pleasing contrast when served with the red or purple fruits.

As will be seen from the table the average yield varies with different sorts from 1.7 pounds to 2.3 pounds, per plant; the mean being about two pounds.

III—FIELD NOTES.

As in previous years cultural methods rather than variety testing received attention in the field.

Effect of Checking Growth before Setting.—The writer has frequently suggested the checking of plants likely to become drawn and "leggy" by cutting back before ready for the transfer to the field. Last season being somewhat cold and backward, there was an excellent opportunity for a comparison. On May 21, a dozen plants of each of three varieties were cut back about four inches and an equal number were left undisturbed for comparison. All were placed in the field May 29.

The results are seen in table VII.

TABLE VII.

VARIETY AND TREATMENT.	First ripe fruit.	Average number fruits per plant.	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.
ITHACA.				
Checked	Sept. 4,	**37**	**10.6**	4.9
Not checked	Aug. 15,	**45**	**14.8**	5.3
NICHOLSON.				
Checked	Aug. 27,	**63**	**12.7**	3.1
Not checked	Aug. 9,	**45**	**9.8**	3.5
OSCEOLA.				
Checked	Aug. 15,	**119**	**16.0**	2.1
Not checked	Aug. 4,	**72**	**9.8**	2.1

The Ithaca plants which were not cut back were superior to the others, but with the other two varieties the reverse was true. This difference is no doubt due to the fact that Ithaca is relatively a late variety, while the others are earlier. It will be seen that in every instance the plants which were cut back were somewhat delayed in maturing fruit, but the growth was enough more vigorous so that with sufficient time the crop exceeded that from the other plants.

Effect of Mulching.—The use of a mulch of straw or other litter as a means of conserving moisture has frequently been discussed. While our own practice is to employ frequent cultivation for this purpose, a comparison of the two methods of treatment was made for purposes of illustration.

Several plants of each of two varieties were placed in adjacent plots, May 29. On June 30, after both lots were well started one plot was given a heavy mulch of fine hay—lawn clippings—while the other was given the same cultivation received by the general plantation. The results are shown in the following table.

TABLE VIII.

TREATMENT.	First ripe fruit.	Average number fruits per plant.	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Per cent of fruit marketable.
DWARF CHAMPION.					
Mulched	Aug. 9	8	2.1	4.1	67.6
Cultivated	Aug. 13	21	5.9	4.5	86.9
CLIMAX.					
Mulched	Aug. 10	14	4.4	4.8	63.5
Cultivated	Aug. 13	43	13.6	5.0	72.1

The plants which were mulched matured a few days earlier than the others; but in every other respect those receiving cultivation were superior. The individual fruits were larger and nearly three times as many as from the other lot, were ripened before frost, while the per cent of marketable fruits was considerably higher.

Frequent vs. *Infrequent Cultivation.*—The importance of frequent stirring of the soil has often been emphasized. As a practical demonstration of the relative effects of thorough and "slack" culture, two lots of each of three varieties were planted side by side and were treated alike in every way except that after removal to the field one lot received only such cultivation as was necessary to keep the weeds in subjection. The soil was a light, sandy loam, and as the season was very dry during the latter part of July and August, the crop, especially from the later varieties, was very light.

Table IX indicates the comparative results.

TABLE IX.

VARIETY AND TREATMENT.	First ripe fruit.	Average number fruits per plant.	Average weight of fruit per plant—pounds.	Average weight of individual fruits—ounces.	Ratio.
ARISTOCRAT.					
Frequent cultivation	Aug. 10	14	3.9	4.5	**1.00**
Infrequent cultivation	Aug. 10.	13	3.6	4.6	**1.08**
MAULE'S EARLIEST.					
Frequent cultivation	July 30	22	8.1	5.4	**1.00**
Infrequent cultivation	Aug. 7	32	11.6	5.9	**1.43**
TRUCKER'S FAVORITE.					
Frequent cultivation	Aug. 21	9	3.6	6.7	**1.00**
Infrequent cultivation	Aug. 18	6	2.2	6.5	**1.64**

The results are not conclusive. Two lots show decided differences in favor of frequent culture; while the third gives as decided indications the other way. It will be observed, however, that in both cases the later maturing sorts are the ones which are benefited by the culture, and it seems not improbable that the other variety, being naturally much earlier, was less affected by the drought.

SUMMARY.

1. The successful cultivation of tomatoes under glass demands good judgment and constant watchfulness on the part of the grower; a large well-ventilated and well-lighted house, the temperature of which can be easily regulated; strong bottom heat, rich soil, care in watering, attention to artificial pollination, and selection of the best varieties.

2. Better results follow the use of boxes than of beds as a receptacle for fruiting plants.

3. There is a marked difference in the adaptability of varieties for house culture, among the best of those tried being Lorillard, Optimus, Chemin, Golden Queen, Ithaca and Long Keeper.

4. The average product per plant should be about two pounds, or one and one-eighth pounds per square foot of floor space.

5. All things considered the Lorillard has proved the most satisfactory tomato for forcing.

6. Plants liable to become drawn and "leggy" before setting in the field may profitably be held in check by cutting back the tops.

7. Plants which were mulched matured a few days earlier than those receiving cultivation, but in every other respect the latter were superior.

8. There was not as much difference as was expected in the results attending frequent and infrequent cultivation.

IV—Notes of Small Fruits.

The culture of fruits is as a rule easier, cleaner, less expensive and often more profitable than that of vegetables. The requirements for labor and fertilizers are less, while with good care the crop is equally certain. From the very nature of the soil and climate of Maine we must look to intensive rather than to extensive operations for the most profitable returns, and at the present time there is no line of work which seems more promising than that of the culture of small fruits. In fruit culture, however, as in all other industries which are profitable, the man who uses his brains will always come out ahead of the one who depends wholly on his muscle. The successful grower must be an efficient, skillful workman, able to put his hand to any of the operations, but his best energies must be spent in planning and directing rather than in executing.

The essential elements of success in small fruit growing as a commercial venture are: Suitable location; thorough preparation; the best varieties; careful planting; thorough culture; the application of business principles in marketing.

THE STRAWBERRY.

A warm, rather moist sandy loam is usually preferred in growing this fruit, but in general any soil that will raise a good crop of corn will rise good strawberries. We would not be understood as encouraging neglect in any way, but the minute directions sometimes given for preparing the soil and for planting are misleading and are enough to discourage any novice from attempting to grow fruit.

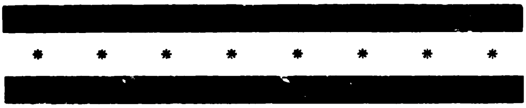
Thorough drainage, either natural or artificial, is absolutely essential, and thoroughness in the preparation of the soil is of prime importance, but the excessive applications of manure and the hand labor frequently advised are unnecessary. It is well to grow some hoed crop as corn or potatoes on the land for one or two years before setting the plants, as in this way there is less danger from attacks of the "white grub."

The month of May is, perhaps, the best time for setting strawberry plants in this latitude, though good results often follow fall setting. Two very important considerations in setting the plants are that the crowns be just even with the surface of the earth and that the soil be pressed firmly about the roots. These points cannot be too strongly emphasized, for to their disregard may be traced more than half the failures in starting new plantings.

For general field culture the "matted row" system is probably best. The rows should be as long as convenient, that most of the labor of cultivating may be performed with a horse. The plants should be set eighteen inches apart in rows which are about four feet apart. Thus placed, a little more than seven thousand plants will be required for an acre. During the first season thorough culture should be practiced. It is also well to keep the runners cut back till the parent plants are strong and well developed.

Winter protection of the plants is always advisable. The value of such treatement is two fold: Not only are the plants protected from injury, but the fruit is kept clean and bright. The best material for the purpose is coarse meadow hay cut before the seeds have ripened. We have sometimes used "shingle edgings" with very satisfactory results. In the vicinity of large mills this material may often be obtained much more cheaply than the hay.

On light gravelly soils we have sometimes resorted to the use of boards on each side of the row of plants as illustrated below:



This device is found a very satisfactory means of conserving moisture and will permit the growth of plants in locations which would otherwise be unsuitable. Naturally this device is recommended only for the home garden.

The question of varieties, although of great importance, is one which must be settled largely by individual growers; for the success of any variety will frequently depend on local conditions. It is always a good plan to have a trial ground for the newer sorts, as varieties of much promise at the Experiment Station may prove worthless in some localities.

In selecting varieties for planting it is well to bear in mind the distinction between the perfect flowering and the pistillate sorts. Many of our most valuable sorts are pistillate and must have some perfect flowering variety interspersed in order to secure the best results.

The following notes represent our estimate of the varieties fruited at the Experiment Station during the past two years:

Beeder Wood. (Perfect).—Small, spherical, uniform in size early in the season but soon "runs out." One of the earliest and most prolific sorts but of inferior quality. Plants quite subject to rust.

Beverly. (Perfect).—Large, oblong or spherical; of a rich dark color, moderately good quality, firm, prolific. A promising variety.

Bubach. (Pistillate).—Very large, irregular; of good color but poor quality, and lacking in firmness. Productive; valuable for near markets.

Charles Downing. (Perfect) —Of medium size, nearly spherical, moderately firm and of good quality. An old favorite for home use, but not as prolific as some others. Quite subject to rust

Crawford. (Perfect).—Large, nearly spherical, uniform and regular; productive and of good flavor, but too soft and too light colored for market.

Crescent. (Pistillate).—An old and deservedly popular sort; but rather small and not of high quality.

Cumberland. (Perfect).—Plants vigorous and prolific; fruits large and of good quality, but too light colored and soft for market. One of the best for home use.

Dayton. (Perfect.)—Medium to large, smooth and regular; of good quality but light colored and soft. Excellent for home use but too soft for market.

Epping. (Perfect).—Plants vigorous and prolific; fruit of medium size, roundish conical, uniform, bright red. A promising variety, received for trial from George Q. Dow, North Epping, N. H., under the name of "Yankee Doodle."

Gandy. (Perfect).—Of medium size, uniform, regular, firm and of good quality. Usually regarded as of special value as a late variety, but has not held its own with us.

Gen. Putman. (Pistillate).—Of medium size, but of pale color, soft and inferior in every way.

Gillespie. (Perfect).—Medium to large, oblong or conical, often with pronounced neck, firm, of good quality and color. One of the best sorts for general purposes.

Greenville. (Pistillate).—Medium to large, roundish conical, uniform, bright red, moderately firm and of good quality. Good for home and near market.

Haverland. (Pistillate).—Medium to large, oblong, regular, firm and of good quality. Plants strong and vigorous; free from rust. A very good sort for general purposes.

Jessie. (Perfect)—An early, sweet berry of good size. Oblong or conical, bright glossy red, handsome and of good quality. It has been one of the most satisfactory with us but is not uniformly reliable.

Jewell. (Pistillate). Of medium size and uniform; but soft and of light color. Not prolific.

Leader. (Perfect).—Medium size, roundish, bright red; fairly good quality. Only moderately productive.

Lovett. (Perfect).—Of the Crescent type. Early, prolific, but running small as the season advances and of second quality.

Michel's Early. (Perfect).—The earliest berry we have grown. Very productive, but small and of second quality. Blossoms very early and the flower trusses are short and well protected. Plants only moderately vigorous.

Mount Vernon. (Perfect).—Medium size, roundish conical, uniform. Of no special value.

Parker Earle. (Perfect).—Very productive, of large elongated fruit having a pronounced neck; firm and of good quality. The plants are very strong and vigorous, but send out few runners, hence should be planted thickly in the row. A valuable sort.

Princess. (Pistillate).—Plant strong, vigorous and productive; fruit a little dull in color, but large, nearly spherical, uniform, moderately firm and of good quality. Medium to late in season. One of the best general purpose sorts.

Sharpless. (Perfect).—Plants vigorous and prolific. Fruit large but somewhat irregular and not always ripening evenly. Of good quality and always reliable.

Smeltzer. (Smeltzer's Early). (Perfect).—Sent for trial by F. H. Smeltzer, Van Buren, Ark. Plants vigorous, healthy and productive. Fruit uniformly of medium size, oblong, firm, of dark rich color and good quality. A promising early variety.

Swindle. (Pistillate).—As grown on our grounds the variety is rightly named. Plants strong and vigorous but not productive. Fruit of medium size, light colored and of very poor quality.

Van Deman. (Perfect).—An early variety; small, spherical; of rich dark color and good quality, but soft and not productive.

Warfield. (Pistillate or with abortive stamens).—Moderately vigorous. Flowers small on short truss and well protected by foliage. Fruit of medium size, firm texture, moderately good quality; ripens evenly, holds its size through the season. Its deep rich color and productive habit make it one of the most valuable market sorts.

West Lawn. (Pistillate).—Sent for trial by C. P. Bauer & Bro., Judsonia, Ark. Plants very vigorous but not productive. Similar in general characteristics to "Cloud," which was sent out a few years ago.

The best of the older varieties above named are; Bubach, Crescent, Haverland, Sharpless and Warfield, with possibly Beeder Wood or Michel's as very early perfect flowering sorts.

Of the newer varieties the following deserve special mention: Beverly, Dayton, Epping, Gillespie, Greenville, Parker Earle, Princess, Smeltzer.

THE RASPBERRY.

The notes given concerning the character and preparation of the soil for strawberries will in general apply to the raspberry. As with the strawberry a rather moist sandy loam is preferred, but lack of such soil need not deter any one from planting. Thorough drainage is, however, absolutely essential.

As is generally known our cultivated raspberries belong mostly to two species—*Rubus occidentalis*, the black caps, and *Rubus strigosus*, the red varieties. A third species—*Rubus neglectus*, has furnished Shaffer, Caroline, and others of the "purple cane" tribe. This species is intermediate in character and habit between those already mentioned and has sometimes been regarded as a hybrid. The European species, *Rubus Idœus*, has also furnished some valuable sorts, such as Fontenay, Brinckle's Orange, Purple Antwerp, etc., but these varieties are not sufficiently hardy for northern latitudes.

The varieties of *Rubus strigosus* are very easily grown and for most purposes are more satisfactory than the black caps. The latter must be handled with great care at the time of setting or fully fifty per cent of the plants will be lost. It is specially important that the crown be placed not much below the surface of the soil. The red varieties, on the other hand, sucker so freely and grow so readily from root cuttings that no special care is required except to comb out the small roots and see that the soil is pressed firmly about the plants. It is well to dip the roots in water before setting—a direction which will hold good in setting any trees or shrubs.

Red rasperries should be set about four feet apart in rows six feet distant; thus requiring about 1,800 plants per acre. If kept in "hills" only five or six of the strongest canes should be allowed in each hill; but a practice very commonly followed is to allow a portion of the suckers to grow between the original plants, forming a hedge-like row.

Clean but shallow culture should follow transplanting. Go through the field with a cultivator as often as once in two weeks till the middle of August. It is, however, unnecessary to "hill up" around the plants. All suckers, except those desired for filling vacancies should be treated as weeds and should be hoed out as they appear.

Pruning is an operation which should receive attention. If done too late in the season, after the canes have become hard and woody, the result will often prove more disastrous than total neglect, as new shoots are developed and these fail to mature before frost. Our practice is to head back the young canes when about two and one-half feet high, and the laterals at about one to one and one-half feet. This method insures strong sturdy growth which does away with the necessity of stakes and trellises. The black caps are treated somewhat differently since longer canes are desired. These it is well to support with a stake.

Winter protection is indispensable with some of our best variaties. The operation, however, is very simple and inexpensive. It consists simply in removing a shovelfull of earth from the side of each bush, bending over the canes and holding them in place by a little earth or other weight. With red raspberries growing in solid rows our practice is to throw a slight bank of earth against the base of the plants, bend them over and lay an old rail or other timber over the tops. The snow will then drift in and afford all necessary protection.

There are at present about thirty varieties of raspberries in the Station garden, but many of these have not fruited and we shall at this time mention only those which have been thoroughly tested.

Cuthbert is perhaps the most satisfactory of the red varieties. The plants are vigorous and productive, succeeding in any reasonable location. The fruit is large and of fairly good quality, but late.

Golden Queen is a sprout from Cuthbert and resembes its parent in every way except color, which is a rich golden yellow. This variety should be in every collection for home use.

Hansell is one of the earliest red varieties. The fruit is of large size and excellent quality while the plants are hardy, vigorous and reasonably productive.

Marlborough is uncertain. Where it will succeed it is a valuable market sort, but the quality is inferior.

Rancocas is valuable because of its earliness. This variety ripens before the strawberries are gone, and is a good sort, but not firm enough for market.

Turner is a good sort for home use, but is too soft and rather small for market. The plant is exceedingly vigorous and hardy. It suckers more freely than almost any other sort.

Shaffer is the favorite variety for canning. Its color is unattractive, however, and it is not generally popular in the markets. It is of vigorous habit and is one of the most productive sorts we have, but is not quite hardy. Because of its value for preserving, and the lateness of its season it is well worthy of protection. It is propagated by tips like the black caps.

We have as yet fruited but few varieties of black caps, and do not advise their general culture.

Of those most commonly grown *Gregg* is perhaps the best. The fruit is large, and the plant is vigorous and productive, but is not quite hardy. A formidable rival of this sort is "Number 101" received for trial from G. C. Brackett, Lawrence, Kansas.

SUMMARY.

1. The essential elements of success in small fruit growing are: Suitable location; thorough preparation; the best varieties; the application of business principles.

2. Winter protection of some kind is always advisable.

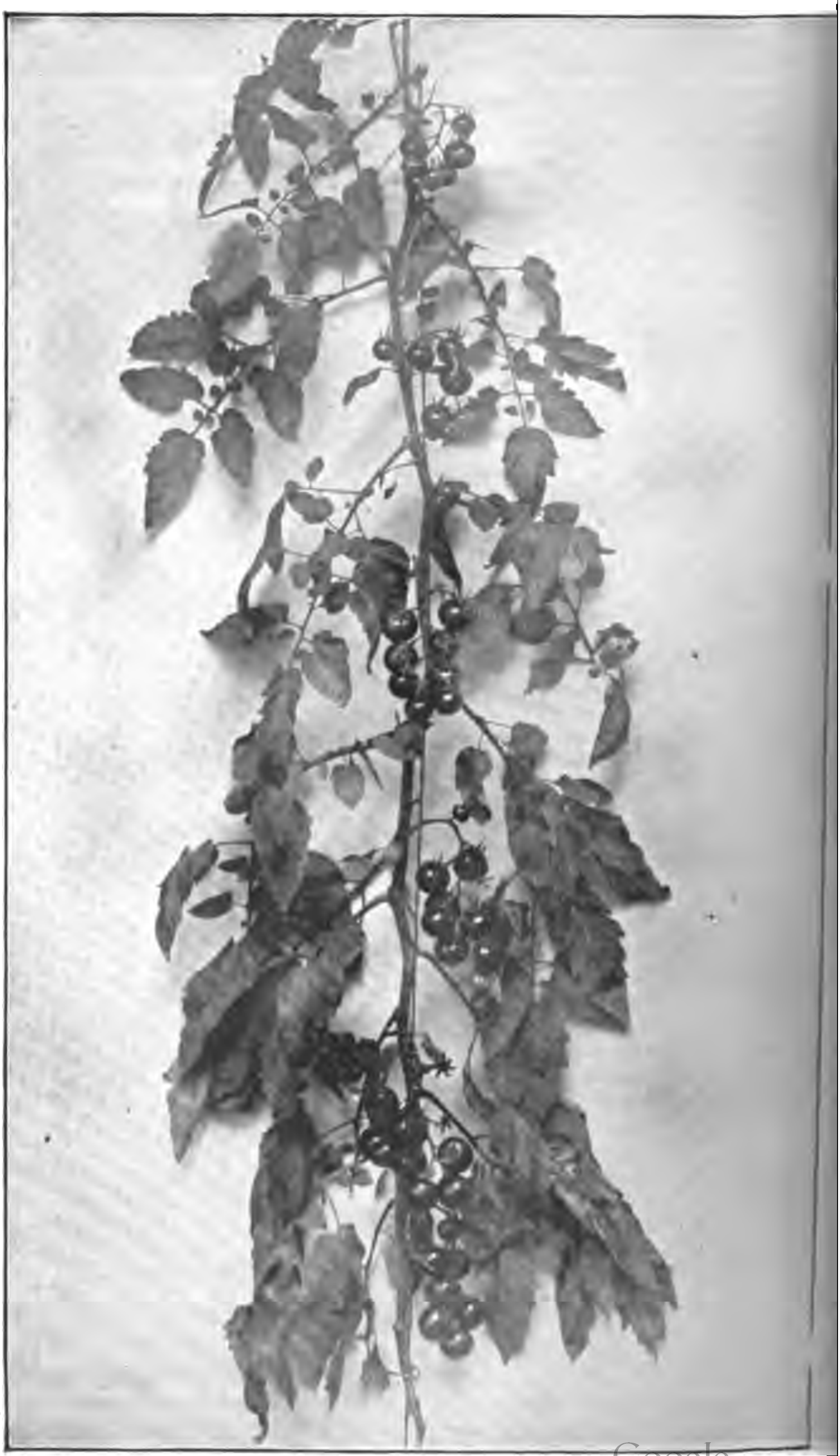


PLATE IV. LORILLARD × CURRANT (THIRD GENERATION).

3. Of the older varieties of strawberries tried, the best are Bubach, Crescent, Haverland, Sharpless and Warfield, with possibly Beeder Wood or Michel's as very early perfect flowering sorts. Of the newer varieties Beverly, Dayton, Epping, Gillespie, Greenville, Parker Earle, Princess and Smeltzer are promising.

4. Of the raspberries thoroughly tried, Cuthbert, Golden Queen, and Shaffer are the best for general purposes. The black caps are not recommended for general culture.

NOTES ON PLANT-BREEDING.

W. M. MUNSON.

To many people the term "plant-breeding" conveys an indefinite idea of some "hobby" which may be attracting the attention of experimenters, and the immediate *practical* value of the work is not recognized. To meet the inquiries frequently received, a brief outline of the nature of our work in this direction is given at this time—a more elaborate discussion of reasons and principles being deferred until a later date.

There are about 107,000 species of flowering plants, and of these 4,233 species are known to have furnished food for man at some time—either habitually or during famine periods. Of this number about one-fourth are, or have at some time been, cultivated for human food. At the present time there are under cultivation to an important extent about 300 species. But many of these species present varieties almost without number. The apple and pear, for instance, have each given more than 3,000 named varieties; the potato nearly 1,000 varieties; wheat, 400; corn, 200; cabbage, 200; pea and bean each, 150, and other species from 10 to 100 or more.

Now the development of this great number of varieties and forms has been the gradual outgrowth in many cases of centuries of care and selection on the part of man. The apple, the pear, the bean, the cabbage, wheat and some others are known to have been under cultivation for more than 4,000 years, while most of our cultivated fruits and vegetables have been known for from 500 to 2,000 years. From the earliest times nature has been producing plants best fitted to meet the struggle for existence. Nature develops plants with the strongest constitutions and with organs best fitted for self-perpetuation, regardless of other features. It remains for man to develop those organs best suited to his needs, regardless of the natural requirements of the species, and to supply the environment necessary to the preservation of the plant. This has been done in some cases to such an extent that the species would be utterly incapable of existence if dropped from cultivation.

Very few plants now cultivated appear worthy of cultivation in the wild state. The radish, for instance, in its wild state closely resembles the wild charlock—*Raphanus raphanistrum*—a familiar weed throughout New England. The potato in its wild state gives hardly a suggestion of the modern White Elephants or Hebrons or Burbanks. The tomato, which has come into general use within the past hundred years, in its wild state is very small and insignificant, closely resembling the cherry tomato now grown mainly as a curiosity.

Necessity is an important factor in directing attention to the food value of a given species or to variations in form or habit which may be of importance. The continual demand made upon the producer for "something new" impels him to send to the uttermost parts of the earth for seeds and cions and plants to meet this demand. This interchange of plants and seeds is, from a practical point of view, of no small importance, and is deserving of careful study. Are seeds and plants grown in Maine better for local use than those grown in Massachusetts, New York or elsewhere? The question involves the general principle of *acclimatization*, and, indeed, opens a broad field for the study of the effect of climate on the variation of plants.

From the time of Lindley (1799-1865) many of the best horticulturists have contended that acclimatization does not exist; that plants can not be modified so as to be perfectly adapted to conditions not natural; that "all plants demand a particular climate—and we have no power over the constitution of the plant itself." One reason for disagreement on this point is that the true meaning of acclimatization is not borne in mind. The term is confounded with *hardiness* or with *domestication*. Acclimatization has been defined as the "state or condition of being inured, by the act of man, to a climate at first injurious." It differs from *acclimation* in that the latter is a *natural process* wholly independent of the agency of man.

But a slight modification due to changed environment is just as truly acclimatization as is a radical change, and at the present time there seems little doubt that acclimatization does occur. The change may occur through the modification of the constitution or habit of an individual plant or through variation of its offspring.

There is a very general opinion that a change in the individual plant is impossible. The truth can only be determined by growing the same plant in different climates. In general, if cuttings be taken from a certain plant to two other localities and from thence after a period of time, plants be taken to a fourth locality, if marked variations are found to have arisen, we must conclude that there has been a modification of the individual plant.

Again, it is well known that peach trees taken from Georgia to Virginia blossom several days later than do those of the same variety taken from New York or New Jersey. As the peach is propagated by buds, it is evident that the same plant has become modified in habit. It is not improbable that the same rule will hold in case of many if not most of our fruits and vegetables.

The method by which acclimatization most commonly occurs is through variation in offspring. The Russian fruits are illustrations in point. These fruits have been bred in a cold climate so long that they are much hardier than are other plants of the same species as grown elsewhere. The Russian apricot, for example, is simply a hardy race of the common apricot—*Prunus armeniaca*—yet it will often stand a temperature of thirty degrees below zero.

Careful observation of a field of beans or corn or tomatoes after a frost will reveal a marked variation in the hardiness of individuals. By selection from these plants hardier strains may be produced. Similar differences in earliness, in habit of growth, in quality, etc., may always be seen.

In other words, no two individual plants are exactly alike, and the application of the principles of selection is of the greatest importance in building up new and valuable types. The key to the whole matter, in the words of Darwin, is "man's power of *accumulative* selection. Nature gives successive variations; man adds them up in certain directions useful to him."

The highest step in the improvement of plants—that of cross breeding—is of comparatively recent origin. It is the climax of all effort in this direction, and to it we must look in our endeavors to secure hardy or otherwise desirab'e sorts of fruits and vegetables in the shortest possible time. It is in this way that we may hope to unite the quality of more southern varieties with the hardiness and productiveness of our northern sorts.

Any one can perform the mechanical operation of crossing plants, but the haphazard uniting of individuals is of little value. To breed plants intelligently we must have a distinct type in mind and work toward our ideal. In order to do this we must have some conception of the effects likely to be produced. The most prominent effects of crossing, as would be expected, are seen in the offspring; and it is of the greatest importance that care be used in the selection of parents. If the parents are very different in character the offspring will probably be weak. But the converse is also true: A cross between closely related species or races is more vigorous than its parent. It is well proved that "crossing is good for the resulting offspring because the differences between the parents carry over new combinations of characters or at least new powers into the crosses. It is a process of revitalization."*

The limits to which cross-breeding is either possible or profitable are not yet well understood. As a rule closely related species will cross readily while widely different species cross with difficulty; but this rule has very marked exceptions. It seems impossible to cross any of the varieties of winter squash—*Cucurbita maxima*—such as Hubbard, Sibley, etc., with varieties of summer squash or with the pumpkin—*Cucurbita pepo*;—while we feel safe in saying the cucumber and the muskmelon cannot be crossed.

In selecting parents the question naturally arises as to which shall be made the male and which the female parent in order to produce certain probable results. It was formerly held that in case of a hybrid the female parent gives constitution and vigor while the male parent gives form, size, color. etc. But at the present time it is generally conceded that the results will be approximately the same no matter which is used as the male or the female parent.

It is not always possible to select our male and female parents at will. In other words, reciprocal crosses are not always possible. For example, I may cross a yellow bush scalloped squash with the summer crook-neck, but I have never yet been able to cross the crook-neck with the bush scalloped. Other cases of a similar nature are not infrequent. Why is this failure? Is it due to a constitutional peculiarity; to the form of the ovarium; to a weakness of the pollen of the one species or variety, or what may be the underlying cause? The question is yet one of the unsolved problems.

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* Cf. Bailey, Cross Breeding and Hybridizing, p. 13.

There has long been a warm discussion as to whether on the parent fruit there are any immediate external effects of crossing. The evidence at hand at the present time would indicate that within certain restricted limits there is an immediate visible effect of pollen as seen in the pea, the bean and Indian corn. On the other hand it is equally certain that the greater portion of food plants which have received special study do not exhibit immediate effects of pollen. Thus this question remains another of the unsolved problems. Some preliminary notes on this subject and some of the other secondary effects of pollination have already been published.*

In all of the work outlined, the laws of heredity play a most important part, and form a legitimate field for investigation. Breeders of fine stock are not unmindful of the importance of pedigree; and in the vegetable kingdom as well as the animal, crossing and selection, combined with suitable environment and intelligent culture—in other words careful *breeding*—with certain fixed types in view afford a field for investigation which is of the highest importance in its bearing upon practical agriculture.

A record of the successive steps in the improvement, of the parentage, of each successive generation constitutes the *pedigree* of a given race or variety. In careful attention to the production of the foundation stock lies the future value of the race. "Pedigree" is of value as evidence of such care.

But "blood" and selection of parent stock alone are not sufficient Better individuals demand better treatment, and some individuals respond to favorable conditions more quickly than do others. So care in rearing is necessary to the maintenance of the type after it is reached.

The field is new and promising. The expense as compared with that attending stock-breeding is slight; while the results are more quickly known and are far-reaching in their value.

To insure the best results, however, we must first learn more of the laws obtaining in this branch of science; we must know more of the relations between cause and effect, that we may proceed along the most profitable lines. But in the search after laws we may employ plants of economic importance that, perchance, the preliminary work may not be without immediate practical value.

As a practical illustration we may cite the development of a new type of tomato which has attracted considerable attention. (The tomato was chosen for the investigation of certain principles because of the rapidity with which results may be obtained.)

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* Report Maine Experiment Station, 1892, pp. 29—58.

The ideal in mind at the beginning of our work with tomatoes was a smooth regular fruit of uniform size and early maturity, bears in large clusters on a sturdy vigorous plant. To this end a cross was made between the little Currant tomato (Fig. 4), which possesses the qualities of earliness, productiveness, and uniformity; and the Lorillard, (Fig. 5), which is of good size and vigorous habit. The resultant hybrid (Fig. 6) was described and figured in a former report.* This hybrid was again crossed with Lorillard for two generations. The prolific habit of the resulting product

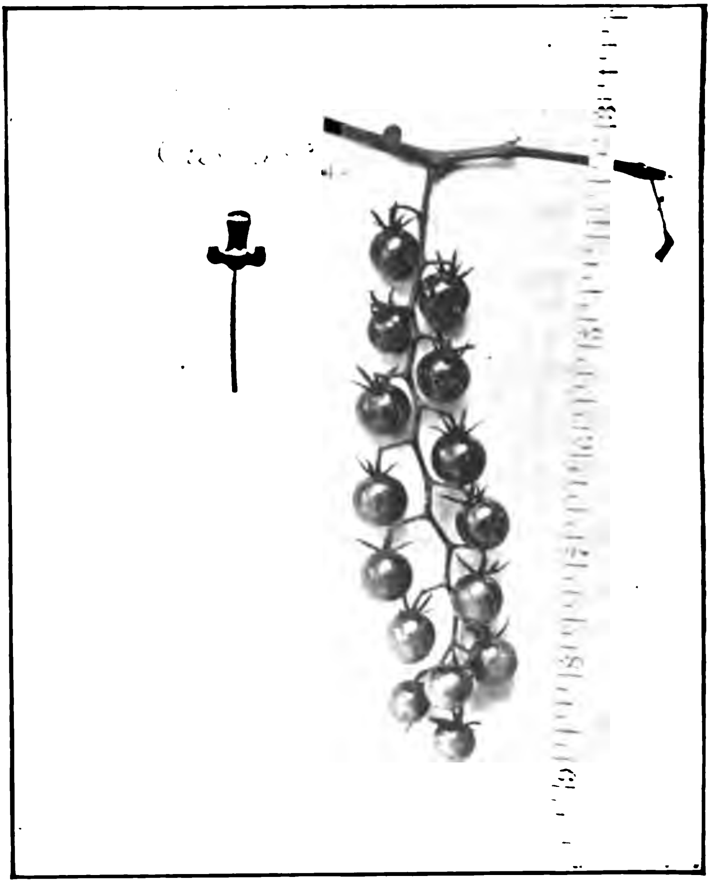

FIG. 4—CURRANT TOMATO.

is shown in plate IV and a cluster of fruit—natural size—from the same plant at plate I. We are now endeavoring by selection to

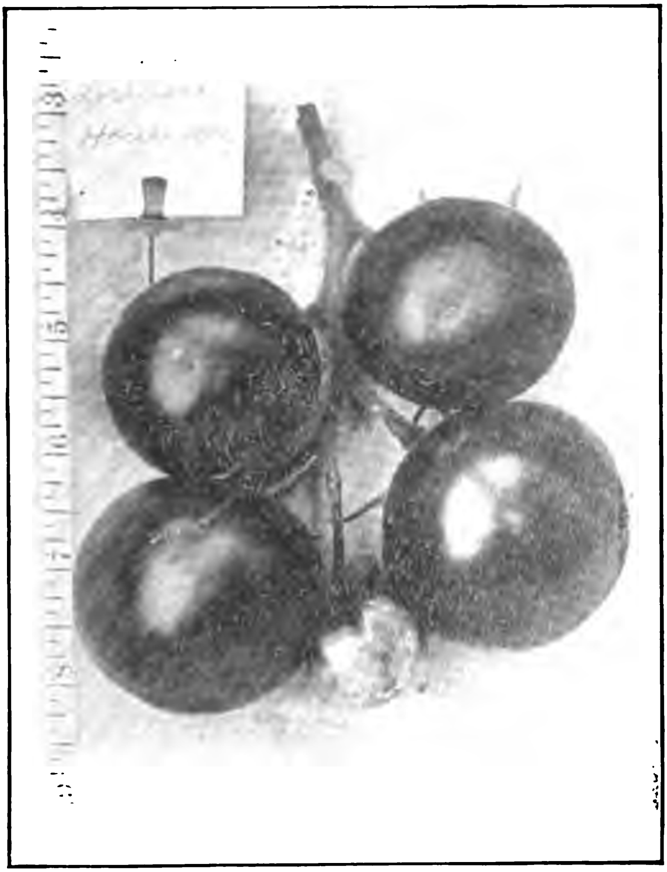

FIG. 5—LORILLARD.

"fix" the type, as we have found that further crossing with Lorillard tends to obliterate the effects of the original male parent.

What then is the ground covered in the general investigation of plant-breeding?

First—A study of the influence of environment, of the laws of heredity and of the principles of selection.

Second—The application of general principles in the production of new varieties of fruits and vegetables to meet special needs.

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*Rep. Maine Exp. Sta., 1892, p. 68.

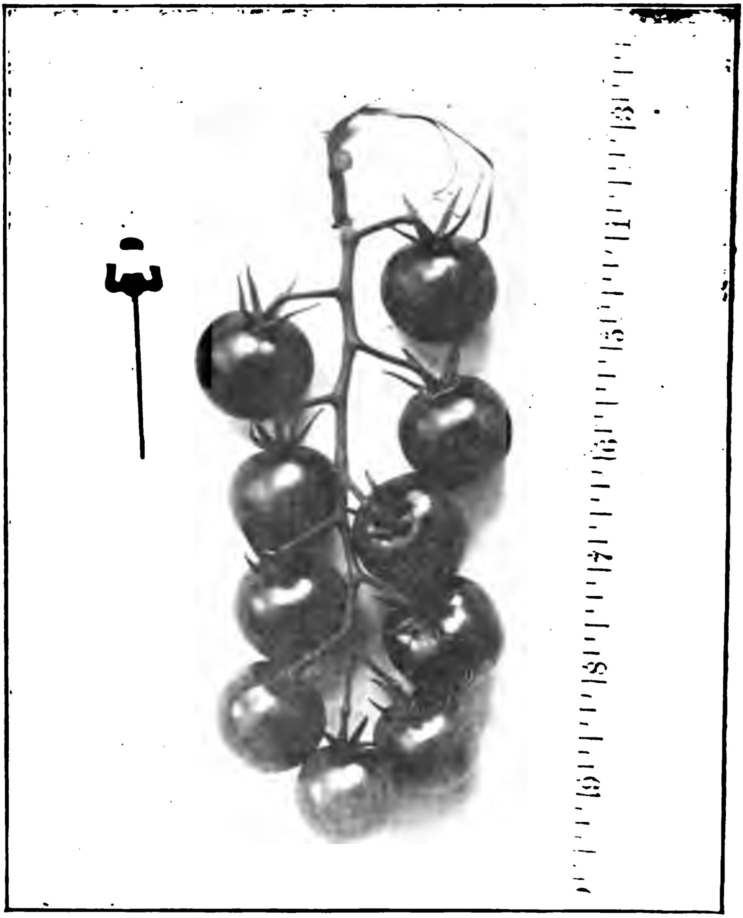


FIG. 6—LORILLARD X CURRANT.

Report of Botanist and Entomologist.

PROF. F. L. HARVEY.

Professor W. H. Jordan:

DEAR SIR—I have the honor to submit herewith my seventh annual report as botanist and entomologist for the Experiment Station. The correspondence regarding injurious insects and fungi, weeds, forage plants and seeds increases rapidly each year. It is gratifying to know that the work of the Station is becoming better known and appreciated. and that the Station is able to extend its usefulness in these directions. As but one-third of the writer's time is given to Station work the correspondence is rapidly encroaching upon the hours that possibly could be better employed making investigations in the field and laboratory. We fully realize that extensive and detailed correspondence must of necessity be an important feature of Station work, though it is only by original research that new facts can be added to entomological and botanical science. We do not desire to limit the correspondence, because the specimens received often are most interesting and important objects for investigation.

The duties of the season have been field work, laboratory investigations, lectures, preparation of articles for the State papers and Science Journals, correspondence and the preparation of this report.

By invitation of the Gypsy Moth Commission of Massachusetts, we visited Malden in July and spent three days in the offices, laboratories and field examining the methods used to fight this insect and submitted to the commission a report of our impressions. In September by invitation and courtesy of Mr. McKeen, we spent two days at Fryeburg examining the area infested by the chinch bug.

Investigations in the laboratory during the season have brought to light several species of insects new to entomological science, some new habits of well known insects, and additional information regarding the life histories and distribution of others. Some new fungi and weeds have been added to the State flora. Descriptions of some of the new species of insect were contributed to Entomological Journals, as the scope of Station reports is limited to matters of economic importance. We were called twice during the season to lecture before farmers' clubs and also delivered fifteen lectures to the winter students in agriculture upon Injurious Insects and Fungi.

Below will be found tabulated the more important plants and insects that have claimed attention. These tables are presented from year to year, as a record of the most important insects and plants claiming attention and are valuable for reference. Specimens new to the State, or of special importance are considered in detail and illustrated.

THE ORANGE RŒSTELIA has been very abundant the past season in southern and western Maine doing much damage to quince bushes. This fungus is considered in detail in the body of the report.

THE PEAR-LEAF BLIGHT which in our last report we stated was spreading in the vicinity of Portland has appeared this season in the Penobscot valley in the vicinity of Belfast and Northport.

The **PEAR-TWIG BLIGHT** (*Micrococcus amylovorus*, Burrill,) has also done some damage about Northport.

The **BLACK KNOT** continues to be reported and will no doubt be prevalent as long as bird cherry, laden with the knots, can be found on nearly every farm in the State.

INCONSPICUOUS HELMINTHOSPORIUM and **COMMON CLADOSPORIUM**, two fungus parasites, feeding upon the juices of the leaves and stems of oats, have been found to be the cause of their dwarfing and prematurely turning yellow.

THE YELLOW ROCKET or **WINTER CRESS**, **FALSE FLAX** or **GOLD OF PLEASURE** and *Berteroa incana*, DC, all plants of the mustard family (*Cruciferæ*) have been found in the State. The first two quite abundant. The third is mentioned as it is a weed new to the State, introduced in 1893 in clover seed. It is associated with **THE DITCHOTOMOUS CATCHFLY** a weed found in the State the past season for the first time and belonging to the pink family (*Caryophyllaceæ*).

THE CANADA THISTLE has been reported as a weed in meadows. It should be eradicated as quickly as possible.

THE ORANGE HAWKWEED as shown by the table, which gives new localities, is spreading rapidly.

THE FALL DANDELION *improperly called Arnica* is also spreading.

The Wild Carrot is also increasing. We saw considerable of it last summer in meadows in western Maine. This is a biennial and should be pulled by the roots.

Authemis tinctoria. A relative of the may weed was received from western Maine and reported as quite abundant.

The Flax Dodder, (*Cuscuta epithymum*, Murr.) was found in some abundance in a clover field in Bradley. This parasite on clover, so far as we know, has not been before reported from Maine.

The Common Snow Flea a small blue-black, wingless, jumping insect found on the snow on warm days in spring was received from Mr. McKeen. It sometimes collects on the surface of water or is troublesome by getting into sap tubs. These simple structured insects are believed by entomologists to be the lowest. They are like the earliest insects that were on the earth, the ancesters of the varied and complex forms of the present age.

The Silver Moth (*Lepisma*) was reported from western Maine. This insect belongs to the same order as the snow flea (*Thysanura*) though quite different in habits. It feeds upon starchy and sugary matter and frequents closets and pantries often doing much damage.

The Ring-banded Soldier Bug was found preying upon the larvæ of the potato beetle. It is figured in the body of the report.

The Elm Tree Bark Louse, *Lecanium Caryœ*, Fitch; *Var Canadense*, Cockerell. There is a bark louse of a mahogany brown color and hemispherical shell. It is very abundant upon elm trees all over the State and must do much damage. The branches in spring are sometimes literally alive with the young lice. These remain active all winter and develop the brown hemispherical scales over themselves the following spring. They can be found during the winter months as small oblong reddish brown objects lying close to the bark on the twigs. The leaves in early summer are often alive with them. The eggs are reddish and oblong. The scales are often punctured by parasites, probably a species of ichneumon, also a species of mite is often found under the scales in great numbers. We have had this species under observation every season for the past eight and there is hardly an elm tree in the vicinity of Orono but what is infested. The scales drop off sooner or later exposing a circular wooly patch. We received specimens from Mr. Moore of Presque Isle during the season showing its wide distribution. We sent specimens to Mr. Cockerell who pronounces it an undescribed variety. Mr. Cockerell has kindly sent us a MSS description which we incorporate in the body of the report.

There has been considerable complaint about an insect that destroys the terminal buds of gooseberry canes causing the growth of numerous small lateral shoots in a cluster near the ends of the branches. The specimens sent us this year and last were not accompanied by any live insects, but as the leaves showed numerous molt skins we concluded it must be the work of *Myzus ribes*, THE GOOSEBERRY PLANT-LOUSE.

THE CABBAGE BUTTERFLY (*Pieris rapæ*) is very abundant in Maine and interferes seriously with the culture of cabbage. There are various subtances that can be applied to check this pest, but none are effectual except *arsenical compounds* applied as spray, or in the form of powder. As arsenic is poisonous it should not be applied after the heads are a third grown.

We receive occasionally a large pale green moth with long tails to the hind wings. This is the LUNA MOTH, a night flying species, the larvæ of which feeds upon the walnut and hickory and no doubt other plants, as it is rather common about Orono and there are no native walnuts or hickories.

THE OBLIQUE-BANDED LEAF-ROLLER does considerable damage to currants and raspberries and other plants of the ROSE family.

We receive the CECROPIA EMPEROR MOTH so often that it is regarded best to publish cuts of this conspicuous species which feeds upon the leaves of apple trees.

The CHINCH BUG which is found over quite a large area in the vicinity of Fryeburg has done quite a good deal of damage annually to grass lands after haying for a great many years. It is not confined to the intervales about Fryeburg, but it has been reported from Bridgton on the east and from the vicinity of Bethel twenty-five miles to the north.

We received specimens of a HAWK MOTH known as (*Smerinthus cerysii*) from Mr. A. N. Townes, Winthrop, Me. This is a rare species and we mention it on this account. The early stages in its life history have never been published. We secured a large number of fertile eggs and have been able to rear the insects and make notes upon all the stages. Prof. Braun of Bangor, and Mr. Ora Knight, one of my pupils, have aided in the study. The notes will be contributed to some Entomological Journal. The species feeds upon the willow and poplar.

The Buffalo Carpet Beetle is doing considerable damage to carpets in southern and western Maine, and has also been reported from Bangor and Belfast. We wrote an article for the Lewiston Journal on this insect, which is published in the body of this report.

The **Maple Tree Borer** or **Beautiful Clytus**, a common insect in Maine, was received from Mr. McKeen and found in Augusta, about maple trees.

The **Pea Weavel** is very common in Maine. We figured this insect in our last report on page 175. This insect can be readily destroyed in stored peas by the use of **Bisulphide** of **Carbon**, as recommended for destroying the **Bean Weevil** in our last report on p. 176.

The Brown Grain Beetle (*Tribolium ferrugineum*, Fab.) was received from *Mr. Edward* of South Paris. The specimens were in middlings which were literally alive with them. It is a brown insect, oblong in form and about one-eighth to three-sixteenths of an inch in length. It frequents neglected grainaries, museums, kitchens and storerooms feeding upon both vegetable and animal matter.

The Oak Bark Beetle (*Magdalis olyra*) was received from Mr. Moore of Presque Isle where it was doing considerable damage to the foliage of elm trees. So far as we know this species has never been reported as an elm tree insect.

Those insects that require more than a passing notice and record are described more fully in the body of the report.

Directions for Sending Specimens

Will be found in the Annual Report of the Experiment Station, 1888, p. 194, or in the Maine Agricultural Report, 1888, p. 158.

Correspondence.

Correspondence regarding injurious insects and fungi is invited. Plants and insects will be named whether injurious, beneficial or neutral. When of economic importance their benefits or injuries will be pointed out and remedies for injuries suggested.

Remarks.

The cuts to illustrate this report were obtained as follows: Fig. 1, loaned by Prof. Halstead; Figs. 7, 8 and 9, from J. B. Lippincott & Co.; Fig. 11, from U. S. Dept. of Agric.; Fig. 5, loaned by Prof. J. B. Smith; Figs. 2, 3, 4, 6 and 12 and Pl. 1, are after drawings made by the writer.

PLANTS REPORTED AND EXAMINED—1894.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	ORANGE RŒSTELIA	*Rœstelia aurantiaca*, Peck	M. B. Whiting, East Northport John A. Dennett, North Berwick,	Fungous disease upon quince trees affecting the twigs. Very common in southwestern Me. in 1894.
2	PEAR LEAF BLIGHT	*Entomosporium maculatum*, Lev	John G. Brooks, Belfast M. B. Whiting, East Northport	Affecting the leaves of pear trees. For description see Ex. Station Report, 1892, p. 109.
3	PEAR BLIGHT	*Micrococcus amylovorus*, Burrell	M. B. Whiting, East Northport	Causing the twigs of pear trees to turn black and the leaves wither. See Me. Ag. Rep't 1889, p. 101 in Pom. Society Report.
4	APPLE SCAB	*Fusicladium dendriticum*	M. Wiggins, Bridgton	Causing scabby spots on leaves and fruit of apple trees. See Ex. Sta. Rep. 1888, p. 149, '89, p. 182, '90, p. 113
5	BLACK KNOT	*Otthia morbosa* (Schw.), =*Plowrightia morbosa*, Sacc.,	John G. Brooks, Belfast John B. Holbrook, Peak's Island,	Infesting plum trees causing warty excrescences. See Me. Ag. Rep. 1889, p. 103 (Pom. Soc. Report.)
6	INCONSPICUOUS HELMINTHOSPORIUM	*Helminthosporium inconspicuum*, C. and E., var. *Britanicum*, Grove. (Sacc. Syll. IV, p. 412,	B. Walker McKeen, Augusta Z. A. Gilbert, North Greene F. L. Harvey, Orono.	Causing oats to turn yellow before maturity.
7	COMMON CLADOSPORIUM	*Cladosporium herbarum* (Pers.), Sacc. Syll. IV, p. 350,	F. L. Harvey, Orono	Causing oats to look sickly and early turn yellow.
8	YELLOW ROCKET—WINTER CRESS,	*Barbarea vulgaris*, R. Br	A. M. Piper, East Madison O. H. Perkins, Sanford	Weed in grass land. Weed in open damp fields.
9	FALSE FLAX, or GOLD OF PLEASURE	*Camelina sativa*, Crantz	A. M. Piper, East Madison	Weed in grass land. See Ex. Sta. Report 1889, p. 185.
10	....	*Berteroa incana*, D. C.	C. H. Gould, North Bridgton, and many others in Western Maine,	Growing in grass land. Introduced in 1893. A bad cruciferous weed.
11	NIGHT FLOWERING CATCHFLY	*Silene noctiflora*, L	F. L. Harvey, Orono	Weed on lawns and waste places.
12	THE DICHOTOMOUS CATCHFLY	*Silene dichotoma*, Ehrb	From many persons and localities which are mentioned in the body of the Report	Introduced in grass seed in 1893, the weed maturing in '94. New to the State. Introduced from continental Europe.
13	CANADIAN HYPERICUM	*Hypericum Canadense*, L	Miss Helen M. Port, Kennebunk	For determination.

14	PURPLE AVENS	*Geum rivale*, L.	O. H. Perkins, Sanford	In low meadows. A weed.
15	COMMON EVENING PRIMROSE	*Œnothera biennis*, L.	E. B. Lufkin, East Orrington	Rank weed in fields and waste places.
16	SUNDROPS	*Œnothera fruticosa*, L.	Stephen Larrabee, Dexter	Weed in grass lands.
17	SWEET SCENTED BED STRAW	*Galium triforum*, Mx	Miss Helen M. Port, Kennebunk	Weed in border of fields and wood land.
18	CANADA THISTLE	*Cnicus arvensis*, Hoffm.	A. M. Piper, East Madison	Weed in grass land.
19	SUCCORY, OR CHICORY	*Cichorium Intybus*, L.	A. M. Piper, East Madison	Weed in grass land.
20	ORANGE HAWKWEED	*Hieracium aurantiacum*, L	F. L. Harvey, Brewer A. M. Lufkin, East Orrington Philip H. Stubbs, Strong Edwin E. Buker, Richmond Cor., Will P. Winslow, Larone	Weed in meadows and grass land. See Experiment Station Report, 1892, p. 106 (illustrated).
21		*Anthemis tinctoria*	C. H. Gould, North Bridgton	Related to the Mayweed. Weed in grass land. Also found in Penobscot Co. about Brewer in 1886.
22	ROUGH HAWKWEED	*Hieracium scabrum*, Mx	Miss Helen M. Port, Kennebunk	Weed in border of fields and open woods.
23	INDIAN PIPE—CORPSE PLANT	*Monotropa uniflora*, L.	Mrs. A. M. Garland, South Dover	In pasture lands.
24	CLOVER DODDER	*Cuscuta Epithymum*, Murr.	F. L. Harvey, Orono	Clover fields Bradley, Me. New to the State.
25	TURTLE-HEAD, SNAKE-HEAD	*Chelona glabra*, L.	Miss Helen M. Port, Kennebunk	Weed in low meadows.
26	NAKED BROOM RAPE	*Aphylon uniflorum*, Gray	Fred W. Cousins, West Kennebunk,	Moist soil by roadside.
27	MAD-DOG SKULLCAP	*Scutellaria galericulata*, L.	E. G. Knights, Waterboro	In low grass land. A weed.
28	CHESS, OR CHEAT	*Bromus secalinus*, L.	W. H. Keith, Winthrop	Weed in grass land and cultivated fields. See Experiment Station Report, 1891, p. 183 (illustrated).
29	YELLOW, OR HOP CLOVER	*Trifolium agrarium*, L	S. H. J. Berry, Wayne	Weed on roadside. Poor for hay.

INSECTS REPORTED AND EXAMINED—1894.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	SNOW FLEA	*Achorutes nivicola*, Fitch	B. Walker McKeen	Abundant in June about the roots of a tree. More often observed upon the snow in warm winter days or in the spring.
2	SILVER MOTH	*Lepisma Saccharina*, L	Mrs. Rose C. Johnson, Gorham,	Very abundant about the pantry. Eating sugar, paste, etc. Also does damage to books and clothing.
3	RING-BANDED SOLDIER BUG	*Perillus circumcinctus*, Stal	Gustavus Pease, Bean's Corner,	Parasite upon the larvæ of potato beetles, piercing the larvæ with the proboscis and sucking out the soft parts.
4	CHINCH BUG.	*Blissus leucopterus* Say	F. L. Harvey, Orono	Doing considerable damage to grass lands after haying, and also some damage to corn fields. Over a large area in the intervales about Fryeburg, Bridgton and Bethel, Me.
5	ELM-TREE BARK LOUSE	*Lecanium caryae*, var. *canadense cockerell*	Delano Moore, Presque Isle	Coccid or bark louse. Very common on elms about Orono, Me.
6	THE GOOSEBERRY PLANT-LOUSE	*Myzus ribis*, L	Delano Moore, Presque Isle	Causing numerous small twigs to start from lateral buds near the end of the shoots, making a terminal bunch of small twigs and dwarfed leaves.
7	HELLGRAMITE FLY	*Corydalis cornuta*	Geo. M. Pillsbury, Lisbon Falls,	The larva which was received by us is called "Dobson" by anglers, and is used as a bait for bass. It is found in ponds and streams.
8	CABBAGE BUTTERFLY	*Pieris rapæ*, L.	Wm. J. Higgins, Fairfield.	Infesting cabbage. Lays its eggs upon cabbage, which hatch into cabbage worms.
9	THE LUNA MOTH	*Attacus luna*	B. Walker McKeen	A night-flying species. The larva is said to feed upon the walnut and hickory.
10	OBLIQUE-BANDED LEAF-ROLLER,	*Cacœcia rosaceana* (Harris.)	Chas. S. Pope, Manchester	Attacking the leaves of currants and raspberries, causing them to roll.

11	CECROPIA EMPEROR MOTH	*Platysamia cecropia* (Linn.)	James Steele, Cherryfield	Cocoons attached to the limb of an apple tree.
12		*Smerinthus cerysii*, Kirby	Albion V. Towns, Winthrop	Found on Bracken Fern. Male and female mating. Food plant, willow and poplar.
13	THE BUFFALO CARPET BEETLE	*Anthrenus Scrophulariæ*	Geo. W. Jeffery, North Monmouth, and several other parties in Western Maine.	Destroying carpets, rugs and woolen garments.
14	THE BEAUTIFUL CLYTUS	*Clytus speciosus*, Say.	B. Walker McKeen, Augusta	The larva boring in maple trees.
15	PEA WEAVEL	*Bruchus pisi*, L	E. T. Perkins, Saco	Doing damage to peas. Causing what are called "Buggy peas."
16	THE BROWN GRAIN BEETLE	*Tribolium ferrugineum*, Fab	Chas. Edwards, South Paris	Found in great numbers in middlings.
17	OAK-BARK WEEVIL	*Magdalis olyra*, (Herbst.)	Delano Moore, Presque Isle	Eating holes in the leaves of elm trees and hazel bushes. Very abundant.
18		*Thalessa lunator*, (Fabr.)	A. B. Ripley, Augusta	Boring into dead maple trees to lay their eggs. This is the largest of our Ichneumons. The ovipositor, fully two inches long. Parasitic upon the Tremex saw fly.

BOTANY.

THE ORANGE-COLORED RŒSTELIA OR QUINCE RUST.

Rœstelia aurantiaca, Peck.

Order *Uredineæ.*

The following letters were received during last July, in which were enclosed quince twigs affected by the above fungus.

EAST NORTHPORT, ME.,
July 25, 1894.

Prof. F. L. Harvey:

DEAR SIR—I enclose a twig from one of my quince bushes, having on it apparently some sort of fungous growth. On some of my bushes this has appeared numerously. It must be very injurious if allowed to grow. Will you please give me your opinion of it? In my limited reading on quince culture I have come across no reference to such a disease. Respectfully,

M. B. WHITING.

We wrote Mr. Whiting regarding the nature of the disease and below is given his interesting reply:

EAST NORTHPORT, ME., July 31, 1894.

Prof. F. L. Harvey:

DEAR SIR—Please accept my thanks for very full description of quince disease contained in yours of 27th inst. I knew of the rust, but was not before aware that it took the form of an excrescence on the twigs. In this case the cause of infection is undoubtedly to be traced to my cedar hedge, which extends in front of house, the quince is growing behind the house and separated from the hedge by it. The quince bushes are young, having been set only last year. The fungus did not appear until this season. The cedar, however, has no fungus on it, and its foliage is almost entirely free from rust or those dead, discolored twigs, which I presume is rust. I think it may be, as you suggest, that my quinces were already affected when I received them, as most of the Geneva, New York, nurseries, whence they came, grow arbor vitae. I had intended to go quite extensively into quince culture, as I think, barring disease, it could be made a success here; but unless I can prevent the rust of course it will be useless for me to attempt it.

Do you think that the Bordeaux mixture would prove effectual, both to cedar and quince? I do not wish to remove my hedge.

Respectfully,

M. B. WHITING.

We also received through Hon. B. Walker McKeen specimens of this same disease accompanied by the following letter from Mr. Dennett.

NORTH BERWICK, ME., July 15, 1894.

MR. SECRETARY—Inclosed I send for your inspection, a growth I find upon three quince trees, I bought from New York nurseries, and set last spring. One each of three varieties, Fuller, Alaska and Meech Prolific. They have started finely, but upon almost every twig there is a growth of this kind. I do not understand it, for it has never appeared on our Orange and Champions that we have had growing for years. Do you think it is anything like the black knot of plum trees that should be destroyed to prevent it from spreading? The trees have started thriftily, but it looks as though this would work their destruction. Can you please tell me what should or can be done with them? I dislike to destroy them unless it shall be necessary.

Very truly yours,

JOHN A. DENNETT.

In answer to some questions regarding the occurrence of cedar trees near Mr. Dennett's orchard we received the following, which strengthens the belief that the nursery stock was infected.

NORTH BERWICK, ME., February 5, 1895.

Prof. F. L. Harvey:

DEAR SIR—In answer to your esteemed note of 29th ult., will say that we have no cedar growth in this vicinity within miles of us, neither do I know of any cedar ornamental growth or hedges about here. The unaffected Orange and Champion were older trees which had been set several seasons, this fungus attacked the new set quince that I had from New York and New Jersey nurseries, (Green's and Lovett's,) hardly a twig of which escaped. I took the precaution to cut off and burn all the fungous growth and if it should appear again this season I will report to you, as it was entirely new to me and of which I am entirely unacquainted.

Very truly yours,

JOHN A. DENNETT.

As this fungus has been very abundant in southern and southwestern Maine during the past season, and is almost sure to appear again, we give for the benefit of all concerned the following account of the disease:

NATURE AND DISTRIBUTION.

This fungus has two stages in its life history, which are found upon very different plants. The *Gymnosporangium* or Cedar Apple stage, which occurs upon the Red Cedar and Low Juniper, members of the Order Coniferæ, and is known as *Gymnosporangium clavipes*, C & P. The *Rœstelia* or Rust stage (known as *Rœstelia aurantiaca*, Peck.) which occurs upon the Sugar Pear, (Amelanchier) Pear thorns (Cratægus), Choke Berry (Pyrus arbutifolia) and the cultivated quince and apple trees, all plants belonging to the Order Rosaceæ.

The first stage of the disease is probably as widely distributed as cedar trees and has been detected throughout the New England, Middle and most of the seaboard Southern States.

This stage of the disease is the *forerunner* of the *Rœstelia* or *Rust* stage, which cannot occur without it. The Red Cedar and Low Juniper are, therefore, responsible for the occurrence of the Rœstelia or Rust upon quince and apple trees. After the *Rœstelia* has become established in quince and apple trees it is *probably perennial*, that is, the mycelium may live in the twigs and produce spores from year to year.

The spores produced by the Rœstelia upon plants of the Order Rosaceæ can only grow when they find lodgment under proper conditions upon cedar trees, and then they produce the *gymnosporangium* stage or cedar apples.

The mycelium of the gymnosporangium is abundant causing the twigs of cedar trees to become swollen and much branched and the leaves to swell to double their natural size and become pointed and spreading. This is well shown in Fig. 1, A, which represents a diseased branch with enlarged and pointed leaves and bearing the reddish or brownish sporiferous masses. Fig. 1, B, shows a normal branch and Fig. 1, C, one of the ovate, two-celled spores which is germinating.

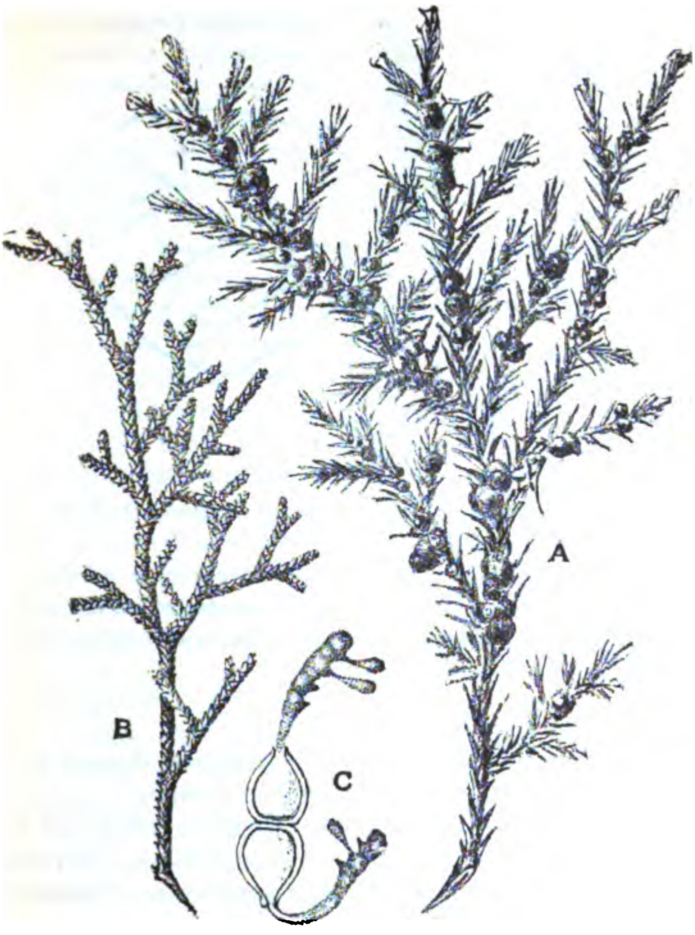


FIG. 1. A—Diseased cedar twig. B—Normal twig. C—Germinating spore.

At a distance this disease gives the appearance of birds' nests in the boughs. It is believed to be perennial.

The *Rœstelia* makes its appearance upon the young fruit and twigs of quince trees and other rosaceous plants early in the summer. It first sends its threads through the host producing orange spots in which pimples appear. From the top of these pimples short shining white horns (Peridia) are developed which are coarsely toothed at the top and contain the bright orange spores.

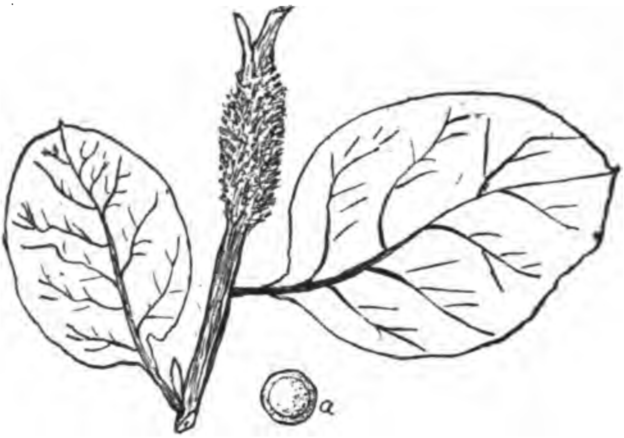


FIG. 2. Quince twig affected by Roestelia. a—Spore enlarged (original).

Fig. 2. shows a quince twig affected by the fungus; Fig. 2, A, one of its spores enlarged.

The leaves of the specimens received were also affected by another species of *Gymnosporangium* (G. *lacerta*) which had passed its prime. Those of *Rœstelia aurantiaca*, Peck, were in their prime when received in July.

REMEDIES.

1. As this fungus is perennial upon cedar trees it could not be killed by spraying with Bordeaux mixture. Possibly if sprayed at the time the spores were ripening they might be killed and prevented from being blown to quince and apple trees. This would be practical only upon hedges and ornamental trees. It would not be practical to spray forest trees. The rust stage of this disease is an *internal parasite* and has done its worst work when the orange patches and excrescences appear on quince and apple twigs, fruit or leaves. It would do the quince or apple trees no good to spray at that time. To spray early in spring when the spores from cedar trees are floating in the air would suggest itself as a preventive measure. To spray when the Rœstelia spores are ripe would probably destroy them and prevent the infection of cedar trees. There have been no spraying experiments tried with this disease so far as we know.

2. As the galls on cedar trees furnish the spores of this disease, all cedar trees in the vicinity of the orchard should be destroyed if possible. This would greatly lessen the chances of infection but

would not entirely remove the danger, as spores of fungi are sometimes carried long distances We have seen this rust upon sugar pear (Amelanchier) where there were no cedar trees nearer than a half mile, and they could be carried much farther.

3. It is probable that this rust is *perennial* upon quince and apple trees. The disease might, therefore, be introduced upon affected nursery stock and be very bad the first season after the trees are set. The experience of Mr. Dennett could be explained upon the basis that the Fuller, Alaska and Meech Prolific were affected when they came from the nursery, while the Orange and Champions escaped because there was no local cause of infection. If this supposition is correct the disease ought to disappear next season if the fungus is annual, or continue and not spread if perennial. It is the belief that *Rœstelia* spores will not spread the disease to other quince and apple trees. We will be much interested in the developments at Mr. Dennett's. There have been no carefully conducted experiments to prove whether the *Rœstelia* stage of this disease is *perennial* nor so far as we know to show *conclusively* that *Rœstelia* spores (æcidiospores) may not produce *Rœstelia* directly. Carefully conducted experiments are needed to settle these points.

4. It would be well to cut and burn the twigs bearing excrescences before the spores are liberated, and also to destroy all affected fruit.

DISEASES OF OATS.

Helminthosporium Inconspicuum, C. & E. *Var. Britanicum*, Grove.

During the summer of 1893 we received through Mr. Z. A. Gilbert specimens of oat plants which had turned prematurely yellow. We were informed that this condition was common in certain portions of the State. As we were unable to find any fungus at work we concluded *as the season was wet* that it was probably a case of malnutrition due to poor drainage and excess of moisture. This season the complaint was renewed by Mr. McKeen. The specimens he sent were found to be badly infested by a species of *Helminthosporium* which we submitted to Mr. J. B. Ellis who decided that it was the species named at the head of this article. It is described in Saccardo's Sylloge IV, p. 412. The type form of this species is reported from New Jersey and New York, upon living and languishing leaves of *Zea Maydis*. The variety is reported from Warwickshire England and so far as we know has not been reported before from the United States. The conidia of our specimens were 40—80x15 m m and 1—5 septate. See Fig. 3. Saccardo gives the dimensions 60—100x12x22 m m and 4—5 septate. The spores of our specimens are somewhat shorter and sometimes with less septa. This fungus is no doubt truly parasitic and capable of producing the languishing condition of the oat plants. In the specimens sent by Mr. Gilbert the disease had not progressed far enough to show the spore, masses which were dark brown colored and appeared as small dark dots or lines upon the leaves sent by Mr. McKeen.

Specimens taken from an oat field upon the college grounds that appeared to be similarly affected yielded, upon examination, another fungus known as

Cladosporium herbarorum (Pers.)

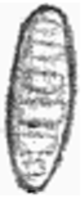
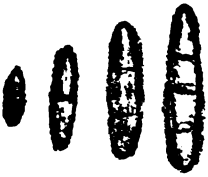


Fig. 3.


Original. Fig. 4.

The conidia of this species are 6—20X5—7 mm and without septa or 2—3 septate. This species is almost world-wide in distribution and attacks members of several botanical families. It is described in Saccardo's Sylloge IV, p. 350. The spores are shown much enlarged in Fig. 4.

The languishing of oat plants in Maine is, therefore, due to the combined action of the two parasites named above. As they are both *internal parasites* we know of no remedy for them. They would probably be much worse in wet, warm seasons and on low land.

NIGHT-FLOWERING CATCHFLY.

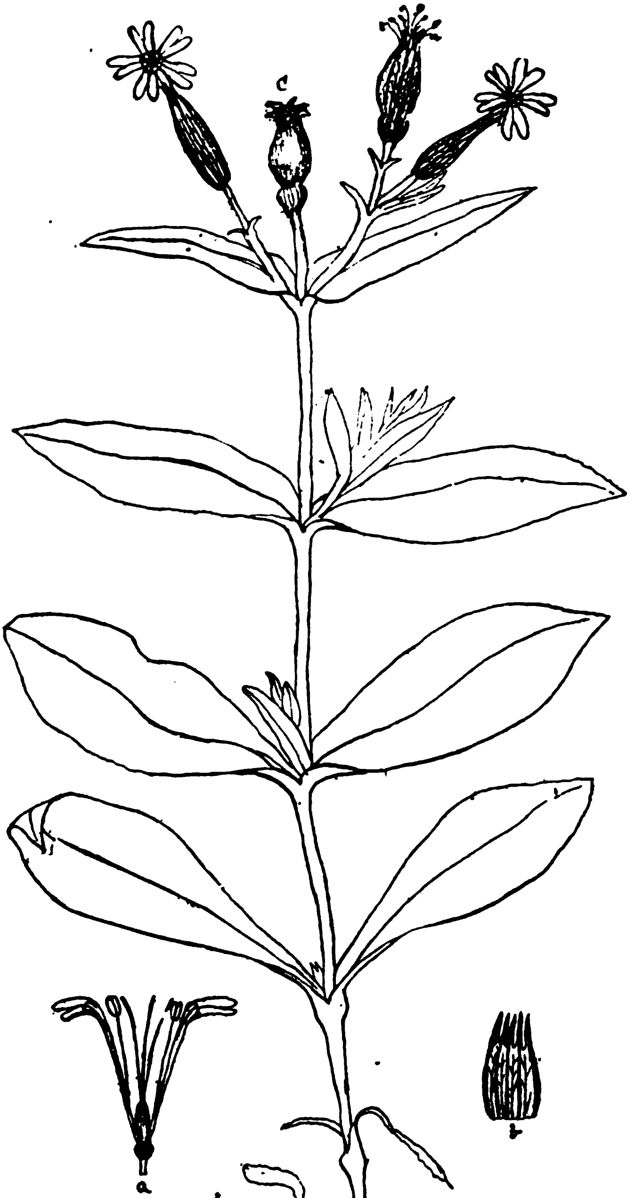
Silene noctiflora. L.

ORDER CARYOPHYLLACEÆ: PINK FAMILY.

This species of catchfly occurs sparingly in Maine in cultivated and waste grounds and roadsides. We found quite a number of specimens the past season upon lawns and waste ground in Orono, probably introduced in grass seed.

It is a coarse plant from three inches to three feet high, with viscid, pubescent leaves. The lower leaves spatulate; the upper lanceolate and pointed. Short, leafy branches, often from the axils of the opposite leaves. Flowers in loose cymes, pedicilate, and usually bearing a single flower, though sometimes more. The central flower of the inflorescence opening first

Calyx large after flowering becoming ovoid, greenish white with ten dark green nerves tending to anastomose, the teeth attenuate. Petals creamy white, often with a tinge of pink, bifid. Flowers about one-half inch across, bearing a ten-toothed crown, closing in the bright sunshine, but open in the shade and on cloudy days. Fragrant. Plant annual, though seeds from the early flowering ones soon sprout, and, we think, often blossom and seed before fall. The plate on the opposite page shows a plant reduced about one-fifth. (*a*) Cross section of flower. (*b*) Portion of calyx showing the anastomosing veins. (*c*) A mature capsule with the calyx removed showing dehiscence.



NIGHT FLOWERING CATCHFLY—*Silene noctiflora*, L. (Original.)

THE DICHOTOMOUS CATCHFLY.

Silene dichotoma, Ehrb.

ORDER CARYOPHYLLACEÆ: PINK FAMILY.

During the past season we have received specimens of the above catchfly from the following localities:

NAME.	ADDRESS.	KIND OF SEED SOWN.
D. B. Johnson	Freedom, Me	Clover, red top and herdsgrass.
Gustave Bellows	Freedom, Me	Clover, red top and herdsgrass.
Daniel Hustus	Freedom, Me.	Clover, red top and herdsgrass.
Frank Johnson	Freedom, Me	Clover, red top and herdsgrass.
Stephen Larabee	Dexter, Me	Red clover, alsike, herdsgrass.
B. W. Mitchell	Dexter, Me	Red clover, alsike, herdsgrass.
Horace S. Martin	Buxton Center, Me	Red clover, alsike, herdsgrass.
E. E. Light	Union, Me	Red clover, red top, herdsgrass.
Nelson W. Adams	Turner Center, Me	Red clover, red top, herdsgrass.
C. H. Gould	North Bridgton, Me	Red clover, red top, herdsgrass.

We also learn that this weed has been found at Farmington (C. H. Knowlton), East Livermore (Kate Furbish), Hartford and North Berwick (J. C. Parlin), and York (E. P. Bicknell.)

The above shows that this weed is widely introduced in Maine. We examined one lot of seed in 1893 that contained over a dozen bad weed seeds and among them the seeds of this catchfly. We condemned the seed. If wholesale dealers who import from other states or countries would receive samples and have them examined before purchasing and each wholesale dealer was required by state law to submit samples to a state inspector before retailing, the introduction of so many bad weeds could be averted. There were at least four bad weeds introduced in the State in 1893-4. It is to the interest of dealers to offer pure seed and they will probably not knowingly sell poor seed. To secure the selection of good seed the Station botanist will aid dealers and purchasers by inspecting samples submitted. From the record given above it will be seen that only one party sowed alsike and that one party who did not sow redtop had the weed, and that all who had the weed sowed

herdsgrass and clover. The weed was therefore introduced either with herdsgrass or clover. As the seed of this catchfly is much larger than herdsgrass, darker colored, different shaped and with a rough surface, it would be easily detected in herdsgrass, while in clover seed it would probably escape detection by the casual observer. It was probably introduced with clover. The seed has been traced directly or indirectly to a single wholesale establishment. The seed was sold in 1893 and two years has elapsed and the dealer has no samples left and cannot tell where the seed was purchased, so it is impossible to trace it outside the State.

This weed was introduced in seed sown in 1893. It germinated that season, lived over winter and bloomed in 1894. After the grass was cut in 1893 the young plants of this weed were abundant proving it to be a winter annual or biennial. The following letter from Mr. Adams gives the facts regarding the introduction of the weed which are confirmed by the other correspondents:

TURNER CENTER, MAINE, July 4, 1894.

Prof. F. L. Harvey:

DEAR SIR—Last year I purchased enough grass seed to seed down an acre and three-fourths. The seed was a mixture of timothy, redtop and clover and was sown with barley on one piece, and with hungarian grass on another. After the grain and grass were removed in the autumn, I saw a great number of plants growing with the young grass and I thought they were oxeye daisies, judging by the form of the leaf, but when it headed and blossomed I found it was something entirely new to me and to every one to whom I have shown it.

I took a plant to Mr. Lyman Abbott, the agricultural editor of the Lewiston Journal. He didn't know what it was and never saw anything like it before. To-day I saw Mr. Z. A. Gilbert and was talking to him about it, and he said if I would send a stalk of the plant to you, I could find what it was and all there was to learn about it. I have seen fourteen or more stalks growing from one root, and the plants on the entire field are as near together as one on every square yard and on much of it as near as one on every square foot; now I am anxious to know if it will spring up from the root after it is cut this year, and if it is a plant that cattle will eat after it is cut and cured as hay, and if they will eat it, if it is healthful or injurious in case they will eat it.

If you can give information on this subject, you will not only oblige me, but a great number besides myself who are engaged in the same business. I am very respectfully yours,

NELSON W. ADAMS.

DESCRIPTION.

This species of catchfly introduced from Europe, is closely related to the *Night Flowering Catchfly* already described. It may be known by the follownig description:

Tall, two to four feet high, more or less clothed with hairs, often reddish and viscid. Probably winter annual or biennial, often over *fifteen* stems from a single root and dichotomously branching toward the top where they bear the one-sided racemose inflorescence. Leaves lanceolate or oblanceolate, those at the base of the flowers near the ends of the branches, small, reddish, three nerved, scarious margined and about half the length of the flowers. Flowers short, pediciled, or nearly sessile, about five-sixteenth inches long; calyx, cylindric in flowering, becoming ovoid in fruit, the ten *bright green nerves* which run from the base to the tips of the lobes strongly hirsute along the back and with *no anastomosing veins*. Diameter of flowers one-half inch, petals white or roseate, obovate, deeply bifid and bearing at the base a two lobed scale which with the others form a crown.

The beautiful seed broadly kidney shaped, light brown, 1.33 mm. × 1.06 mm. Its surface densely covered with elevations arranged concentric and radiate from the hilum. Those near the hilum narrow, smaller, darker, smooth, bordered and unmarked. Outward from the hilum the papillæ become larger, more conical, oblong, bordered by from 10 to 20 teeth and bearing at the summit a round black dot. The teeth of the contiguous papillæ often interlock.

This species can be told from the other catchfly which we figure by its numerous stalks from the same root, its greater height and more slender growth, dichotomous racemose inflorescence, nearly sessile flowers and the veins of the calyx, which do not have branches running across from one to the other.

TREATMENT.

This plant is a winter annual or biennial. The seed sown in 1893 sprouted that year and the young plants lived over winter,and after producing flowers and seed in 1894 died *root* and *branch*.

Of course the best way would be to have seed inspected and reject all that contained the seeds of bad weeds. As this is not practical at present, farmers will be compelled to sow such seed as is offered to them and fight the weed pests that appear. With this particular one nothing could be done the first season. If the plants are prevented from seeding the second season that is the end of them. Some have gone to the trouble of pulling the plants up by the roots, believing the roots to be perennial. This was unnecessary, but the tops should be cut to prevent re-seeding.

Some of the specimens received about the first of August were fully seeded and the seed capsules open. If cut in that condition many of the seeds would be scattered. The plant should be cut as soon as the flowers begin to appear or before. The plant stools badly and each stalk bears several flowers and each capsule has numerous seeds. A few scattering plants would, if neglected, seed a field abundantly. We have had no experience, but doubt whether this weed would make hay. Those who have neglected to cut this weed carefully or have cut after the seed were ripe may expect to see it next season.

POTATO SCAB.

Botanists are agreed that this disease of the potato is caused by a fungus parasite, *Oospora scabies*, Thaxter. That the germs of a fungus will retain their vitality in the soil for several years.

That seed free from the disease will produce a scabby crop if planted upon soil contaminated with the germs.

That scabby seed planted upon soil free from the disease will produce a scabby crop.

That probably the disease is modified by the moisture, fertility, composition and mechanical conditions of the soil.

The source of the disease would therefore be either the *soil* or the *seed*. Conditions could never cause the disease; the germs must be present either in the seed or in the soil. To prevent contamination from the soil potatoes or beets should be grown upon *new* land, that has never grown potatoes, or if upon old soil, that which has not grown potatoes for a number of years. To prevent contamination from seed it should be selected from a field known to have been free from the scab.

If the origin of the seed cannot be determined then select the tubers that appear free from the disease, and soak them for an hour and a half in a solution of corrosive sublimate or Bordeaux mixture, to kill any germs present.

EXPERIMENT.

To test the efficacy of treating the seed with corrosive sublimate we took some potatoes that were slightly scabby and divided in two lots, one of which was treated two hours in a solution of 2 ounces to 16 gallons of water, and the other not. A portion of the untreated seed was planted, adjoining on each side of the treated. All was fertilized and cultivated the same. The soil had not grown potatoes for four years

The untreated seed came up before the treated and the tops appeared more vigorous during the whole season and obtained a fourth greater growth, and the weight of tubers was much more. All the potatoes were about equally scabby.

CONCLUSIONS.

1. That the germs of potato scab will retain their vitality in the soil for at least four years, as shown.

That if the germs are in the soil the treatment of the tubers with corrosive sublimate will not prevent the disease, and is apparently of no advantage.

That corrosive sublimate has a poisonous effect upon potato plants, depressing their vigor and lessening the yield, when the tubers are treated for two hours. (Our observations agree with those of Professor Taft, who says (Mich. Expt. Sta. Bull. No. 108) that treatment for longer than one and a half hours lessens the amount of scab but reduces the yield.

The only advantage then in the use of corrosive sublimate solution is when suspicious seed is to be planted upon nncontaminated soil.

FORMULA.

Dissolve two ounces of corrosive sublimate in two gallons of hot water and then add fourteen gallons more before using. *Remember that corrosive sublimate will corrode any metal vessel and a wooden receptacle should be used.*

Soak the seed in this solution for one and a half hours, dry, and it is ready to plant.

ENTOMOLOGY.

THE SNOW FLEA.

Achorutes nivicola, Fitch.

ORDER THYSANURA: FAM. PODURIDÆ.

Specimens of the above insect were received from B. Walker McKeen June 13, 1894.

This is the *blue black* insect found in such great numbers upon snow on warm winter days, and also at various seasons upon the surface of pools. They often congregate by the thousands upon tree trunks near the base. Those sent by Mr. McKeen were found near the base of an elm tree. These insects *hybernate* in grass about the base of trees and elsewhere, and about the bark of trees. On warm days in winter they come out. The name *Snow Flea* is usually applied to the above species though we have found four other species at Orono during the winter months upon snow. These and related insects are known by the name of *spring tails* because by means of a forked appendage attached to the abdomen they are able to execute leaps. The color is blue black or dark lead color, and the size from one-tenth to one-fifteenth of an inch.

THE SILVER FISH.

Lepisma sacharina, L.

ORDER THYSANURA: FAM. LEPISMIDÆ.

We received the following letter from Mrs. Johnson, accompanied by specimens which proved to be the above species.

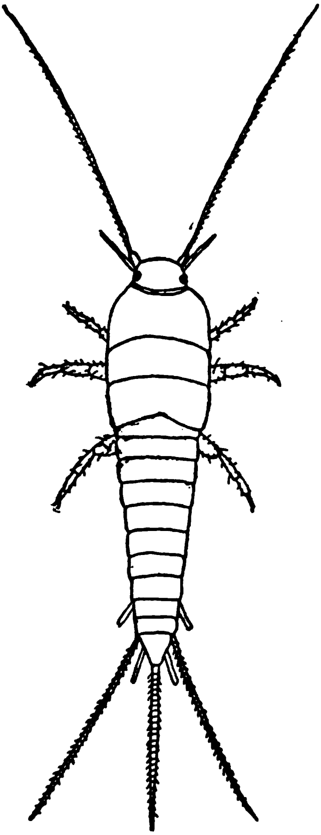


FIG. 5.

GORHAM, Me., Aug. 24, 1894.

F. L. HARVEY.

Dear Sir:—I have sent you three specimens of a bug (?) that has been troubling me this year. Some time in May a beetle, similar in shape to the illustration of the carpet beetle in this week's Lewiston Journal, appeared in the dish closets and on food when it was left exposed. In color it was a silvery gray. It was about a third of an inch in length. About the first of June they disappeared but soon after came in the form of the specimens which I have sent you. These are in everything — dishes, food, clothes, shoes, etc., but I have failed to find any real mischief which they have done.

Please write me what they are.

The buffalo bug is in at least one house in Gorham.

Yours truly,

ROSE C. JOHNSON.

The species of beetle spoken of was probably the common Meat Beetle, *Dermestes lardarius*.

This species may be recognized by the accompanying cut. The insect is of a uniformly dull silvery color, excepting the feet and antennæ, which are pale yellow. The size is about one-third of an inch. Mrs. Johnson has given the habits correctly. "They are in every thing." They are capable of doing considerable damage in libraries and wardrobes, by eating the paste from books, and holes in fabrics. They are very active. As these insects are fond of starchy or sugary substances, they could be destroyed by poisoned sweets.

This same species has also been reported from Brewer, Me.

THE RING-BANDED SOLDIER-BUG.

Perillus circumcinctus, Stäl.

ORDER HEMIPTERA. FAMILY SCUTELLERIDÆ.

We received through Mr. McKeen the following letter accompanied by a specimen of the above well-known parasite upon potato beetles:

BEAN'S CORNER, ME., August 6, 1894.

HON. B. W. MCKEEN, Augusta, Me.:

SIR—I send you herewith a bug that seems to like to stick his proboscis into the larvæ of the potato beetle and lie back and enjoy life as long as there is anything left in the larvæ. I presume you are acquainted with him, but he is a stranger to me. They do not seem to be numerous at present. Perhaps you would give his life history in one of your bulletins.

Yours resp'y,

GUSTAVE PEASE.

This is the first time this insect has been reported to the Station, and as we have not observed it in the State, it is desirable that it be known and protected as a friend to the potato grower. It is a beautiful insect and is sure to attract attention. It may be known by the following description.

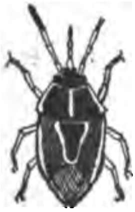


FIG. 6.
(Original.)

Length about one-half inch, width about one-fifth inch. Polished dark brown marked with cream colored bands as shown in the figure. The thorax and scutellum are coarsely punctured.

Head brown above and yellow beneath, mouth parts brown, antennæ five jointed, darker toward the ends, eyes black and prominent, proboscis four jointed, the terminal two black and also the base of the other two on the *under* side.

Thorax arched, polished brown, darker toward the head, bordered above on the sides and in front by a cream colored band which also extends down the middle of the thorax. The *pro thorax*, below, narrowly bordered with cream color and a narrow line of the same color down the middle mesathorax below, with a narrow yellow curved line in front of the second legs and down the center.

Scutellum bordered by a cream colored band.

Wings.—The hard portion bordered laterally by a cream colored band.

Abdomen bordered by a yellow brown band and down the center below a row of four blotches of the same color. The general color below, brown, legs brown, the tarse nearly black. The tibia on all the legs encircled in the middle by a band of yellow.

The mature insect enlarged about one-half is shown in Fig. 6.

THE ELM TREE BARK LOUSE.

Lecanium Caryæ, Fitch, var. *Canadense*, n. var.

ORDER HEMIPTERA: FAMILY COCCIDÆ.

Extract from a paper, by I. D. A. Cockerell, about to be published in the "Canadian Entomologist:"

Scale smooth, shiny, red-brown, convex, malleate but not or hardly plicate. Length 4, breadth 3, height 2 m m., varying to length 5, breadth 4, height 3 m m. (Some Maine specimens 6 m m. long.) Removed from the twigs, the scales leave an oval white mark. (Nappan scales are paler and more yellowish, also somewhat smaller. Posterior incision perhaps a little longer; scales also rather more tending to be plicate.) Male scale ordinary, rugulose.

With 6 jointed antennæ, formula 326154. 3 considerably larger than the remaining joints put together, 1 with 2 hairs; 2 with 2 hairs at its end, one especially long; 3 with 2 hairs near its end, last joint with several hairs, one especially long. (Nappan antennæ practically the same, but 1 larger; 4 and 5 each show a hair, 6 hardly so long, formula 3(126)54. Maine antennæ show one long hair at end of 3, 2 with 1 very long hair, 2 a little longer than 4, 4 a very little longer than 5, 6 a little longer than 2; formula 36245.) Derm obscurely tessellated, with large gland-pits. (In Maine specimens gland pits frequently in pairs.)

Femur not much larger than tibia. Tarsus hardly 1-3 shorter than tibia; distinctly swollen at base. Claw rather stout, curved at its tip like a falcon's beak. Digitules of tarsus apparently wanting (deciduous?) Digitules of claw large and distinct, extending well beyond tip of claw, stem moderately stout, knot large and oval. A bristle on end of coxa, one on end of femur and one on end of tibia. (Nappan scales show legs much the same, but femur proportionately longer, tarsus only a little swollen at base; tarsal digitules well developed, long, ordinary; digitules of claw short, not extending to end of claw; claw stout, nearly straight not hooked. Maine examples show coka stout, broader at base than its length, with a hair at its tip; trochanter with a long hair; femur longer than tibia, tarsus about 1-3 shorter than tibia; digitules all filiform.)

Eggs.—(Maine specimens) very pale pinkish.

Hab.—The types are from Stittsville, about 20 miles from Ottawa, Ontario, on *Ulmus racemosa*, sent by Mr. Fletcher. Other specimens are from Nappan, Nova Scotia, on elm (Fletcher) and Orono, Maine, on elm (Harvey). Prof. F. L. Harvey states that it is very abundant at Orono; he has known it for 8 years, and it is increasing. The branches are often almost covered with them.

The Stittsville examples are affected by a coccinellid and by an Encyrtid parasite, perhaps a *Chiloneuras.*

The species is quite different from the European *Lecanium ulmi*, and is doubtless a native of this country. It illustrates well the extreme difficulty of dealing with the American species of *Lecanium;* which have, perhaps, not succeeded in reaching a condition of specific equilibrium since the new developments, which doubtless followed the termination of the glacial epoch. It will be seen from the above, that the characters given are quite variable, unless we are dealing with three species instead of one—a view which I cannot for a moment entertain. While thus convinced that all these elm forms are strictly one thing, I have a very lively conviction that *L.ribis*, Fitch, is different—a conviction which I feel sure would be shared by any one who had seen quantities of both—yet it is difficult to point out the precise nature of the difference, apart from the smaller size of *ribis*. Two species of Fitch, *L. Cynosbati* and *L. Caryœ* have been re-described by Signoret, who shows that they have 6-jointed antennæ like *ribis* and *Canadense*. I have not seen authentic examples of either, but the description of *L. Caryœ* agrees so nearly with our elm species that I place the latter under it as a variety."

The above description refers to the bark-louse found so abundantly upon the elms in Maine and referred to in the introduction as The Elm Tree Bark-louse, which Mr. Cockerell describes as a *new variety*.

THE GOOSEBERRY PLANT-LOUSE.

Myzus ribis, L

ORDER HEMIPTERA: FAMILY APHIDÆ.

We have received from Mr. Delano Moore and other parties during the last three years, specimens of gooseberry twigs, in which the leaves at the end of the branches had been killed, resulting in the development of several short sub-terminal shoots, making a terminal dense cluster of short branches and small leaves. Careful examination of several specimens did not reveal any insect at work, nor could we find any evidence that the main shoot had been infested by either insect or fungous parasites. There were present in several specimens the moult skins of a species of aphis or plant-louse, which we presumed had to do with the injury.

The species mentioned above is known to infest currant and gooseberry bushes, causing the leaves to curl and blister, and though we were not able to identify the species from the molt skins, suspect it is responsible for the injuries.

To secure the insects for examination it will be necessary to search for them earlier in the season. The attention of those who have been troubled by these *terminal growths* on gooseberry bushes, is called to the matter. We would like to receive specimens earlier in the season. When the terminal leaves begin to show injury.

THE OBLIQUE-BANDED LEAF-ROLLER.

Cacœcia rosaceana, (Harris.)

ORDER LEPIDOPTERA: FAMILY TORTRICIDÆ.

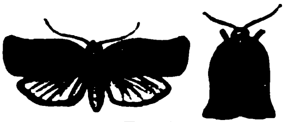


FIG. 7.
The moth of the oblique-banded, leaf-roller.

On June 11, 1894, we received specimens of the larvæ of this insect from Mr. Charles S. Pope, Manchester, Me. Accompanying the specimens were currant twigs showing the work of this insect. To make sure of the species we allowed the larvæ to transform.

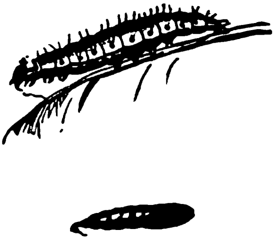


FIG 8.
Larva and pupa of the oblique-banded leaf-roller.

This insect is a general feeder having been found upon many species of the ROSE and SAXIFRAGE families and probably feeds upon the leaves of the plants of other families. The name leaf-roller applied to this insect is derived from the habit the larvæ have of rolling the leaves of the food plant into hollow cylinders in which they live.

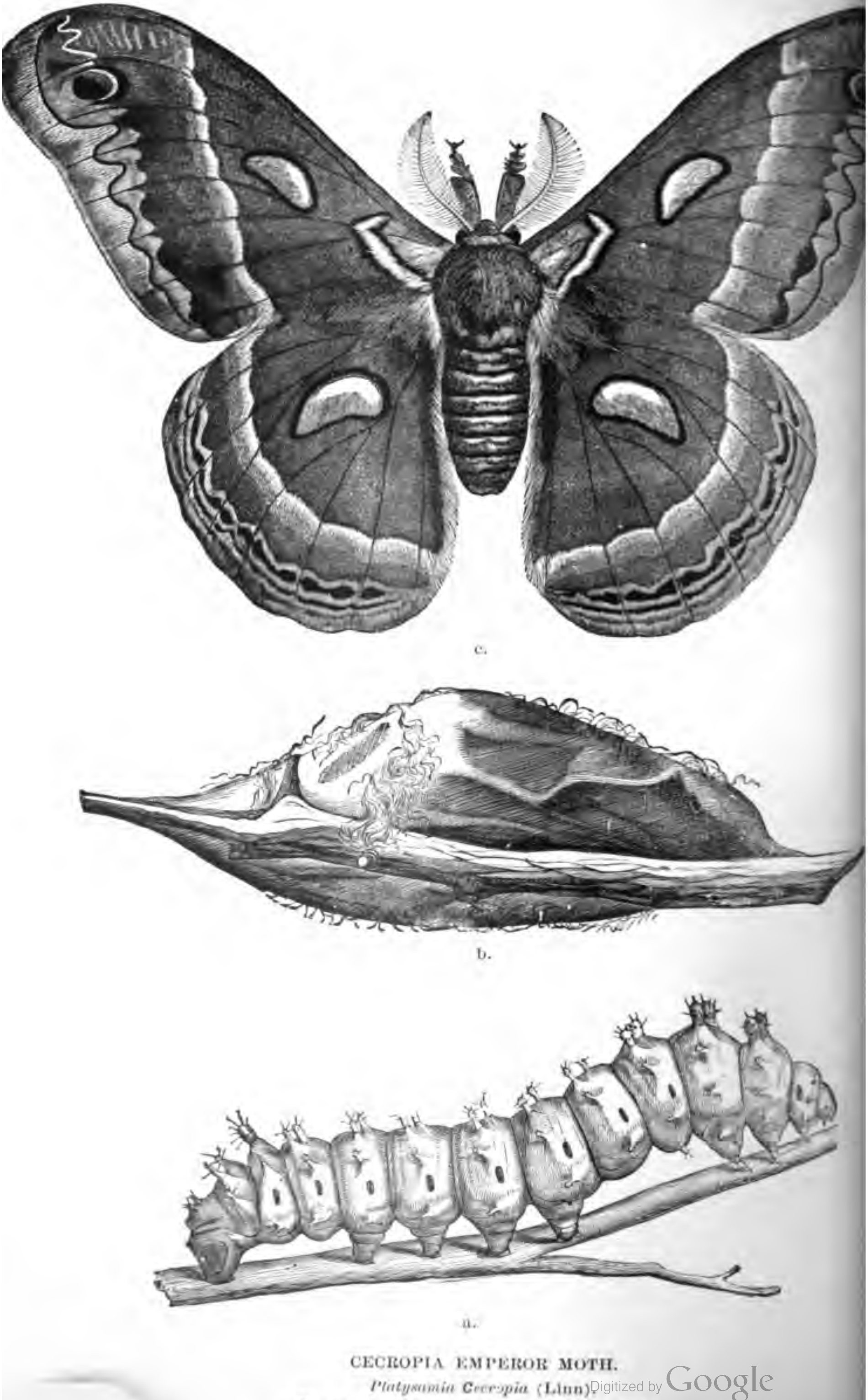
DESCRIPTION.

This insect may be known in the *larval* form by the pale green, yellowish green or reddish brown color with the head and top of first segment brown. There is a dark green stripe along the back and a few smooth dots from each segment bearing a short fine hair. The cut, Fig. 8 shows the larvæ somewhat enlarged. When full fed the larvæ changes to a chrysalis within the tube in which it lived.

The chrysalis is shown, Fig. 8. From the chrysalis the bell shaped moth shown in Fig. 7 comes forth.

REMEDIES.

The clusters of rolled leaves should be pinched and the larvæ killed if within reach. Spraying with pyrethnum or Paris green would kill them.



CECROPIA EMPEROR MOTH.

Platysamia Cecropia (Linn).

FIG. 9. (a) Larvæ. (b) Cocoon. (c) Moth.

THE CECROPIA EMPEROR MOTH.

Platysamia Cecropia, (Linn.)

ORD. LEPIDOPTERA: Fam. BOMBYCIDÆ.

Every season for the last eight we have received either larvæ cocoons or moths of the above species accompanied by letters of inquiry. We have concluded to publish cuts of all the stages of this conspicuous insect. Those who wish a description will find it in Expt. Station Rept., 1890, p 121. The insect is distributed throughout the State as specimens have been received from every section.

Fig. 9 a, represents the larvæ full size; Fig. b, the cocoon full size; Fig. 9 c, the full sized moth.

THE CHINCH BUG.

Blissus leucopterus, Say.

ORDER HEMIPTERA: FAMILY LYGÆIDÆ.

In company with Hon. B. Walker McKeen we spent two days last September in the vicinity of Fryeburg examining the area infected by chinch bugs.

HISTORY.

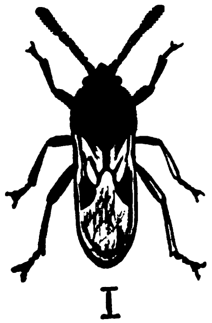


FIG. 13. CHINCH BUG. The short line below shows natural length.

By interrogating some of the oldest inhabitants we learned that this pest has done more or less damage in the intervale lands about Fryeburg for at least twenty-five years. It does not affect the area infested uniformly, but occurs in patches, often skipping entire farms. Nor is the infested area the same from year to year. Farms infested one season may become exempt the next and those not infested one season infested the next. Then there are seasons favorable for the bugs when the damage done is greater over the entire area and then seasons of minimum damage. The insects do

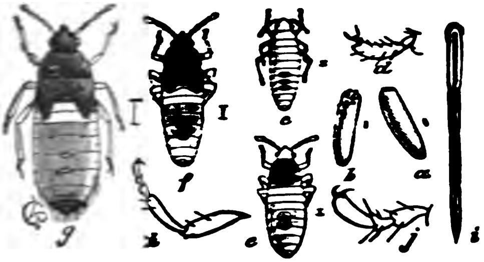


FIG. 14. CHINCH BUG, LARVA, PUPA AND EGG.

a and *b*, eggs; *c*, young larva; *d*, tarsus of same; *e*, larva after first molt; *f*, larva after second molt; *g*, pupa; *h*, leg; *i*, beak or tubular mouth; *j*, tarsus of mature bug.

not occur in such hordes as they do in the West even in the worst infested farms. In small fields there were many isolated patches of a few feet or rods in extent. Only in one or two places did we find large continuous areas infested. They were the worst in the low, sandy lands, but were found in some places on the uplands, notably on the farm of Charles Chandler, Fryeburg Center.

RECORD OF OBSERVATIONS.

We began our observations at the farm of Mr. B. B. Woodward, N. H., where we found the bugs in abundance, in small patches in grass lands. This farm is the *southern limit* of the infested area so far as we know, though they may be found farther south. Proceeding north we visited the farms of E. W. Burbank and Henry Andrews, where the insects were working in patches. The grass was dead and dry in one of these fields and the bugs were abundant on the edges of the dead patches extending their depredations. We burned over one of these patches to see what would be the effect on the bugs, and found that only a few of them were killed. They work so deep about the roots of the grass that the heat does not reach them.

At the farm of Charles Chandler, Fryeburg Centre, they were working upon the uplands and at George A. Charles' farm they had destroyed the whole field. At the farm of Wilson Webb they had been working in a field of corn. They had destroyed the adjoining grass land and injured a few rows of corn at the edge of the field. We found a large number of dead bugs covered with mold in the sheaths of the leaves but was not able to decide that the fungus was the cause of their death.

The fungus proved to be a common mold and originated, probably, in the juices exuded where the leaves were eaten and finally extended to the dead insects. So far as we could learn but little damage is ever done to corn by this pest. They were doing much damage on

John Hastings' land near the above corn field. At Dexter Walker's there was a fine field of corn adjoining grassl and badly infested. It would seem that they do not leave the grass for corn as long as the food supply holds out. Mr. A. K. Price had already plowed his grass land to destroy the insect. If the bugs are bad the land would have to be reseeded and by plowing early and deep, the bugs would be buried and destroyed. We called on Mr. Simeon Charles from whom we originally received specimens and found his fields infested. The most northern place of their occurrence known to us positively is the farm of Albion Wyman, North Fryeburg, but we have good reasons for believing they occur about Bethel, twenty-five miles further north. They occur throughout East Fryeburg and also in Bridgton, the township on the east. We stopped at several other places than those mentioned and noticed the work of the bugs in several fields as we drove by. The above places mentioned will outline the infested area, which would appear to be about seven miles long by about two wide. Those who wish a description of this insect will find an account of it in Experiment Station Report, 1892, page 124, besides other information historical and remedial.

REMEDIES.

In Illinois and other western states where the chinch bug occurs in great numbers, over large areas, attempts have been made to destroy them by infecting with fungi, the principal one being (White Murcardine, *Sporotrichum globuliferum*, Speg.)

The results of these experiments have been so uncertain that we regard any attempt to control or destroy the pest by this method in Maine as time wasted. The fact that the insect works in isolated patches makes the problem in Maine a different and difficult one. In the West the bugs affect the wheat and small grain early in the season and as soon as this is harvested they migrate in hordes to the corn fields. In Maine small grain is not grown to any extent. Before haying the bugs live on the grass leaves and after haying do not migrate but transfer their depredations to the roots of the grass, killing everything as they go, remaining in the grass land as long as food supplies hold out. They are particularly destructive to timothy grass lands. Chinch bugs are very sensitive to wet weather and are never so bad in damp, rainy seasons.

The following suggestions may prove helpful in checking the pest:

1. Watch the fields after haying and if the bugs begin to work in patches as shown by dead places in the grass then *at once* spray the living grass for a distance of ten feet where the bugs are feeding along the edges of the patches with kerosene emulsion.

2. Should the bugs appear over the whole or the greater part of a field there is no hope of saving it but in order to destroy the bugs the land should be plowed deep and rolled as soon as possible after haying.

3. So far as possible it would be well to burn grass lands. The burning destroys some and the remainder are more exposed during the winter to injury. After haying or early in the fall all rubbish about the fences and border of the fields should be raked in heaps. The bugs will seek the rubbish for winter quarters. The rubbish should be burned late in the fall or very early in the spring.

4. The chinch bug feeds only on plants of the grass family. Fields badly infested could be planted to clover, buckwheat, beans, potatoes, turnips, etc., and the bugs starved. Frequent rotation of grass with the above crops would tend to keep them in check. If by concerted action all of the infested field in the area could be turned after haying the same season, it would go far toward destroying the pest. Whatever method is adopted there should be concerted action. The chinch bug does not travel very much and the application of remedial measures and its suppression becomes largely an individual matter. No farmer can lay the blame for its presence and depredations upon the inactivity of a shiftless neighbor.

THE BUFFALO CARPET BEETLE.

Anthrenus Scrophulariæ, L.

ORDER COLEOPTERA: FAMILY DERMESTIDÆ.

During the last few years we have received letters from the western and southwestern part of Maine regarding an insect doing much damage to carpets and woolen clothing. Several times these letters have been accompanied by specimens, leaving no doubt that the pest is the insect whose name appears at the head of this article. This insect is called the buffalo bug in Maine, but in other localities is variously known as the carpet beetle, buffalo carpet beetle and buffalo moth.

Perhaps the many common names given to an insect is of little importance, but they are confusing and are apt to annoy the systematist who insists upon exact use of terms. To the practical man the important points are identification; a knowledge of how to cope with it, if injurious, and how to utilize its good qualities if beneficial.

This insect belongs to the order Coleoptera, which embraces the hard-winged insects called beetles. To call it a "bug," which is the name belonging to insects like the squash bug (*Hemiptera)*, or to call it a "moth," which is a term restricted to a portion of the scaled winged insects (*Lepidoptera*) would be entomologically incorrect. This insect is properly called a beetle, and in allusion to the shaggy appearance of the larvæ, and the fact that it injures carpets the name Buffalo Carpet Beetle would be appropriate.

HISTORY AND DISTRIBUTION.

The insect was first described by Linnæus in 1758. On account of its feeding upon plants of the genus *Scrophularia* he named it *Anthrenus Scrophulariæ*. It is now known, however, to feed upon a wide range of plants including fruit trees, tulips and roses. Though a vegetable feeder by nature it readily changed its dietary and in Europe as early as 1779 was known to frequent houses and to destroy collections of insects and plants, clothes, furs, leather and victuals. It was known in Europe in 1855 as The Common Flower Beetle. It is an interesting example of the power some insects have of adapting themselves to new surroundings and new food.

Though known in Europe for over a hundred years, it was not detected in America until 1850, when Dr. Le Conte found a variety of it on flowers in California. It was, according to Le Conte, probably imported during the Spanish occupancy of that country. It was on the Pacific coast that it was rechristened "the buffalo bug."

In the Eastern states they were first discovered near Buffalo, New York, in 1872, and a little later in Massachusetts. Dr. Hagen investigated the matter in Boston, and found that the infested carpets came largely from a single large carpet house, and he inferred that the pest was introduced in imported carpets.

Since its introduction it has spread more or less, and is now known in all of the New England states, as far west as Illinois and as far south as Washington. In Europe it has not figured as a carpet beetle, as carpets are little used, and rugs more common. The insect is retiring in his habits and does not thrive in rugs, which are frequently taken up and shaken. Perhaps in the growing custom in this country of using rugs, housekeepers will find a means of controlling this insect, which is now in many localities the greatest household pest.

We have but little data regarding their introduction or even distribution or prevalence in Maine. Nearly eight years ago we received a single complaint, and presume they have been in the State for years. They probably came in from the way of Massachusetts through carpets purchased in Boston. We have had complaints from Bangor and Belfast, the eastern part of the State. This article, we hope, will call attention to the pest and bring it to light and help determine its distribution. We will be pleased to examine any carpet insects sent us, *but be very careful if specimens are sent to put them in a tight tin or metal box, which should be inclosed in an outer wooden or pasteboard box.* We would also like to have those who know positively that the buffalo carpet beetle is in their neighborhood send a postal card to that effect. There are several other small beetles that destroy carpets, also carpet moths, and besides other harmless small beetles are often found in houses, and are liable to be mistaken for this pest. The only safe way is to have the insect identified by an entomologist. Prof. Lintner gives a case where a beneficial beetle (a lady bug) was mistaken for the buffalo carpet beetle.

DESCRIPTION.

Eggs—We find no description of the eggs in any work at hand and have no specimens to examine. They must be very small, and the belief is that they are laid by the female on the carpet or clothing attacked and not in the cracks of the floor, as some suppose.

Larva—The full grown larva is about a quarter of an inch long, dark brown and clothed with stiff brown hairs which are longer on the sides than on the back and still longer on the extremities. These hairs form tufts at the sides and extremeties. The posterior end bears three tufts of long hairs and the head a bunch of shorter ones. Fig. A shows the back view of the larva much enlarged, the real size being shown by the hair line at the right. Fig. B shows the under side enlarged.

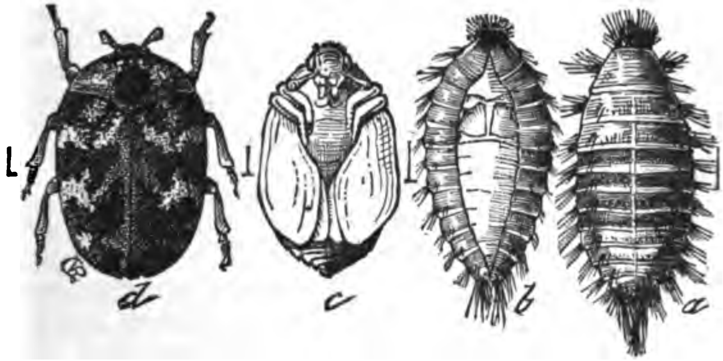


FIG. 10.

Pupa.—It is shown in Fig. c, enlarged. The real size being shown by the hair line at the left. It is brown in color and is the quiescent stage in the life history of the insect between the larva and the perfect beetle. The larva moults six times at least in coming to maturity. and finally the pupa is formed in the last larval skin, and after a time this larval skin splits open along the back, revealing the pupa from which later the full grown beetle emerges. The cast-off larval skins are usually found in abundance, giving the impression of a greater number of the pest than really exists. The larva are very tenacious of life and will go a long time without food. We kept some one time in a tin box for nearly a month without food, and they were still alive. When deprived of food the growth is slow and the moults more numerous. It is the larva that does the mischief.

Perfect Insect.—A beetle three-sixteenths of an inch long and nearly as broad. The broadly elipical outline is shown in Fig. a, which is enlarged, the real size of the beetle being shown by the hair line on the left. The beetle is black and white and scarlet. The ground color is black with three irregular white bands across the wing covers [elytra] and a scarlet stripe down the middle of the back widening at three points to meet the three irregular white bands. The antennæ are black, eleven jointed and bearing a three jointed club at the end. The head is black marked about the eyes and mouth by a few orange red scales. Under side of the body black with red and white scales. The color is variable. Sometimes the red band down the middle of the back is white and sometimes the two anterior white bands are confluent, forming a broad band of white.

LIFE HISTORY.

The beetles begin to emerge in the fall and continue to appear during the winter and spring. There is believed to be but one brood in a year, though the time of emergence of the beetles would depend upon the conditions of heat and cold and food supply in the houses and rooms frequented. In heated houses and rooms they would transform more rapidly, while scarcity of food has been shown to prolong the life of the larva and increase the number of moults. When on the wing they may be found often on window panes and in the fall out of doors upon plants of the sunflower and figwort families. Though Professor Riley thinks they lay their eggs in the house before they leave it we see no good reason why they may not, as they do in Europe, lay their eggs and maintain themselves out of doors. The beetles soon pair after they merge and the eggs are supposed to be laid upon the clothing and carpets effected. The eggs soon hatch, if the temperature is favorable, and the young larvæ attack the exposed edges of the carpet, clothing, etc , often following a single thread or stripe in a carpet for a long distance. When mature, in the fall, having moulted at least six times, they seek cracks in the floor or other places of concealment and transform to the pupa state within the last larval skin. The pupæ finally ruptures along the back and the beetles emerge, completing the round of life.

REMEDIES.

Difficulties.—This is a very difficult insect to exterminate, the despair of the shiftless housekeeper and nearly a match for the fastidious, uncomfortable ones who are ever upon the alert for the last speck of dirt and first indications of insect pests.

It does not readily yield to the ordinary insecticides like camphor, cedar oil, pepper, tobacco, turpentine, carbolic acid and pyrethrum, etc. Benzine when properly applied has been found to be the most convenient and best remedy. Even with this the most energetic and persistent measures are necessary. The aim should be extermination of the pest in the house, as a few overlooked would multiply rapidly and increase the difficulty.

Precautions.—[*a*] There are quite a number of carpet insects, beetles and moths. The first step should be the positive determination of the pest doing damage Learn to recognize the larvæ, pupæ and beetles and then wage a ceaseless war against them in every stage of their life history. If you do not know the insect, or can not decide from the description given above that it is the buffalo carpet beetle, then put some specimens in a tight metal box and send them to the entomologist of the experiment station at Orono, Me., and he will cheerfully name them.

[*b*] Remember that benzine is an inflamable liquid. Do not bring a light near it. Do not apply benzine to a room in the evening when lights are burning or enter a room with a light when it is filled with the vapor. It is well enough to keep a room closed while the benzine is being applied so it will not evaporate too rapidly. The strength of the vapor favors the destruction of the larvæ and beetles.

Having decided that you have the buffalo carpet beetle to grapple with, then apply the following remedies.

PREPARATION OF ROOM.

As the larvæ crawl into cracks in the floor and under the baseboards to transform, precautions should be taken to fill, so far as possible, these hiding places.

a. Fill the cracks in the floor and the crevices at the bottom of the baseboards carefully with a moderately thick mixture of plaster of paris and water. This will set hard and prevent their entrance.

b. Should the use of plaster of paris be inconvenient or undesirable, then, by means of a hand-atomizer charged with benzine, puff the liquid thoroughly into all the floor cracks and crevices about the baseboards. It would be well to leave the carpets off a few days and make the second application of benzine before putting them down.

c. When cleaning house it is best to take up all the carpets at once, and thoroughly clean all the rooms before putting any of the carpets back. The common way of cleaning one room at a time and returning the carpet at once would give the pest a chance to fly or crawl from one room to another while the work is going on.

d. It has been recommended to put a strip of tarred roofing paper around the border of the room before the carpet is laid. This would no doubt help to repel the attacks of the beetles and would be desirable if the odor was not objectionable. The odor of napthaline, gasoline and bisulphide of carbon and kerosene make the use of these efficient remedies undesirable in the house. A tight box filled with the vapor of bi-sulphide of carbon from above is used by naturalists to disinfect museum specimens and it could be used to disinfect carpets out of doors. It is very volatile and highly inflammable. The vapor is very heavy, being two and a half times as heavy as air and settles rapidly.

PREPARATION AND CARE OF CARPETS.

a. In Europe this beetle is not known as a carpet pest because the use of carpets is not common. Rugs which can be taken up and frequently shaken are more in use than in this country. In a badly infected house it would be well, if possible, to discard the use of carpets for a time and use rugs, taking them up frequently and shaking them. A more extreme measure would be to discard carpets and rugs for the summer season. If carpets are used they should be taken up at least twice a year, thoroughly beaten and lightly sprayed with benzine and left out of doors until the benzine evaporates. Leaving carpets down the whole season and then cleaning them carelessly gives the pest fine chances to increase unmolested.

b. As the larvæ attack the exposed edges of carpets, they are usually found around the border of the room.

If the depredations of the insect are noticed between the times of house cleaning and it is not convenient to take up the carpet then take a damp, folded sheet or cloth and spread it smoothly over the infested spot and iron it thoroughly with a hot iron. Allow the iron to remain long enough to generate steam sufficient to penetrate the carpet and destroy the insects. If thought desirable the whole room could be so treated but the benzine method would prove less laborious. Some leave the carpet untacked and turn the edges back occasionally and examine them carefully.

c. When you buy a new carpet from a local dealer in the infested district, or import one from the larger cities, it would be well to examine it carefully and spray it with benzine before putting down. There is no doubt that the pest was introduced in carpets purchased in the city or cities where the pest has been found in the large carpet houses.

d. The custom of sending carpets to the cleaner has its danger as a cleaning house would be very apt to harbor the pest. When returned, carpets should be sprayed with benzine before putting them down.

e. Carpet cleaners in the infested district could easily arrange [illegible] give all carpets a dry hot air or steam bath of from 160° to 200° and thus thoroughly disinfect them after they are cleaned.

f. Carpets to be stored for the summer should be thoroughly beaten, disinfected by spraying with benzine and put into a tight box, the cracks of which have been previously sprayed with benzine. A box can be made tight by pasting paper over the cracks. Some line boxes with tarred paper and sprinkle napthaline crystals (*crysta alba*) in the fabric. This is better than camphor gum and is a good expellant, is cheap, and leaves no stains or offensive odors behind.

Care of Clothing.—Clothing to be stored should be treated as recommended for carpets. Drawers or boxes in which infested clothing has been stored should be thoroughly sprayed with benzine.

Furniture.—Cloth covered furniture should be thoroughly steamed or sprayed with benzine.

If the methods advocated above are carefully applied for two or three seasons, even so difficult a pest to exterminate as *Anthrenus Scrophulariæ* will be compelled to yield.

THE OAK-BARK WEEVIL.

Magdalis olyra (Herbst).

ORDER COLEOPTERA: FAMILY CURCULIONIDÆ.

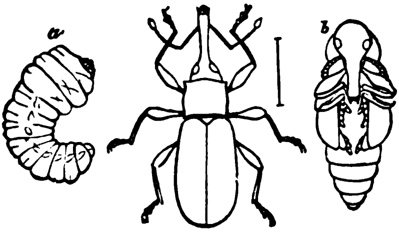


FIG. 11. Larva, pupa and beetle of Magdalis olyra.

Specimens of the above insect were received from Mr. B. Walker McKeen and sent him by Mr. Delano Moore of Presque Isle. They were said to be feeding on the leaves of elm trees in that region. This being a new habit for this species we wrote Mr. Moore asking him to send more of the insect and some of the leaves upon which it was feeding. Here we give a cut of one of the leaves showing the nature of the work. Mr. Moore writes that this species was also very abundant upon hazel bushes in June, destroying the leaves. We sent some of the beetles to Dr. Horn, who pronounced them the above species.

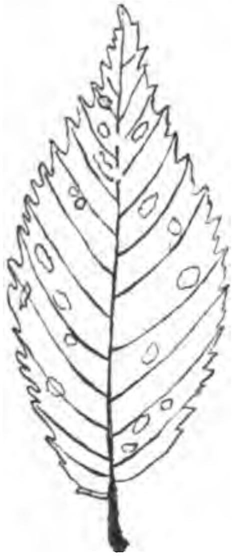


FIG. 12. Elm leaf eaten by Magdalis olyra (original).

Dr. Packard says [in Forest Insects, p. 80] that this species infests *oak trees*, the larvæ living under the bark. We do not know whether the larvæ attack elm trees or not, but possibly this is so, as the perfect beetle feeds on the leaves. This species can be recognized by the cut and following description: Color dark reddish brown to nearly black, clothed with short lighter colored hairs. The base and tips of femora and rest of the legs including the antennæ pitchy reddish. Length one-fourth to one-third of an inch.

We know no remedy. Should it confine its attacks largely to hazel bushes it would be more beneficial than otherwise.

THE FALL CANKER WORM.

Anisopteryx pometaria, Harris.

When we first began to observe this insect in 1887 it was not very abundant about Orono and did no material injury. It gradually increased from year to year and in 1893 had become so abundant as to do much damage to orchards and shade trees. The foliage of trees on the college campus and in Orono were so badly eaten that it was feared they would die. For some unknown reason, probably from the increase of parasites that prey upon this species, it almost entirely disappeared during 1894 and has given no trouble whatever about Orono in the summer of 1895. The insects seem to be migrating or passing over the State like a slowly moving wave from the north toward the south. Its depredations have gradually spread down the Penobscot valley. In 1893 they were very abundant in Arnold and Prospect and this season (1895) they are doing so much damage to the shade trees in Thomaston that a town meeting will be called to consider the means necessary to check them. Mr. E. P. George, President Thomaston Improvement Company, writes that "canker worms appeared upon a few of our fruit trees about four years ago. They have increased in numbers each year and gradually spread to the elms until this year fully three-fourths of the eight or nine hundred elms and fruit trees in the village were completely infested and deprived of their foliage by the end of June." The trees about Orono were not killed. They no doubt suffered a severe shock and the growth for a season or two was greatly checked but they seem to have regained their usual vigor. It took the worms about five years to reach the period of greatest numbers at Orono and if they have the same experience at Thomaston with them they will not be so abundant next season. It is well known to entomologists that insects have gradual periods of increase and then suddenly decline. We had a very good example of this in Maine in the case of the FOREST TENT CATERPILLAR, which is fully explained by rapid increase of parasites, (see Station Report 1890, page 138.)

Report of Veterinarian.

F. L. RUSSELL.

TUBERCULIN AS A DIAGNOSTIC AGENT.

No apology need be offered for a report relating to bovine tuberculosis. The importance of the subject is excuse enough.

Those who are impatient at the amount of attention the subject is receiving from all quarters need to realize its importance more fully than they do. It is doubtless possible to take extreme ground in advocating the importance of tuberculosis from a sanitary and economic standpoint, but the general public is so far from realizing the true importance of the matter that there is need of even these extremists. There is no safety in ignorance or indifference. Safety consists in recognizing existing dangers, and adopting the most efficient means of combating them. The world moves; and this is true even in relation to medical science and it has been especially true during the last ten years. Greater advance has been made in our knowledge of the causes of disease during the past ten years than in the fifty years preceding. And with the increased knowledge of the causes has naturally come a corresponding knowledge of the means of preventing and of curing disease. The magnitude of this progress, and its far reaching results in prolonging life and preserving health it is yet difficult to realize.

The most progressive and enlightened can hardly comprehend it, and it is in no way strange that the public that is to be directly benefited is somewhat slow to accept facts that are new and not well understood. Knowledge must always be in advance of practice, and there are never lacking those extremely conservative individuals who cling to the old until nearly everybody else has acknowledged the value of the new. These individuals have their place, no doubt, and act in some measure as a balance wheel, but progress is made in spite of them and not with their help. There are those even at the present time, who are decrying vaccination against small pox and insisting that it does more harm than good but vaccination is almost universally practiced in civilized countries in spite of them, and thousands of lives are saved by it.

Tuberculosis is by far the greatest scourge among diseases that has cursed this earth through all the past centuries as far back as history extends. As the effects of light, air, food and exercise upon the health of the individual have come to be realized many lives have been saved, and those sick, even with consumption, have been restored to health. But it was with the discovery in 1884 of the tubercle bacillus and the establishment of the fact that it was the active agent in producing all forms of tuberculosis that the foundation was laid for substantial progress in overcoming this disease. Whether it will ever be possible to cure a large proportion of cases is still in doubt, but it has become entirely evident that it is possible to prevent its attack. The deep seated convictions of centuries are not easily changed, and necessary means cannot immediately be put in operation. There has to be time for the popular intelligence to appreciate the need and the advantage to be gained. Considering that only a little more than ten years have elapsed since the important discovery I have mentioned, was made, great progress has already been made. Houses in which consumptives have lived are disinfected, some degree of isolation of tuberculous patients is attempted, and the food supply is watched that it may not carry disease. That these precautions are everywhere or even generally adopted, is not true, but they mark a decided advance and give promise of the time when, with a more general knowledge of the means to be used and greater appreciation of the advantage to be gained we shall have laws, well sustained by public sentiment, that will successfully control the spread of tuberculosis among man and beasts. When this time shall come many years will be added to the average duration of human life, and it would seem that the way is prepared for bringing about this desired end almost within the next generation. The time must come, and should come soon, when every case of tuberculosis shall be attributed to gross carelessness or almost criminal negligence in not using well recognized and reliable preventive precautions. In this regard we wish to deal with a phase of the subject that has vital relations to public health, and is also vastly important from an economic standpoint. However opinions may differ in regard to the absolute relation between human and bovine tuberculosis it is generally conceded that tuberculosis of cattle affects in some degree the public health, and if it were not for the pecuniary side of the question, there would not be the slightest protest against destroying every case of bovine tuberculosis as soon as it could be discovered by any available means. Some degree of danger to human beings from tuberculous cattle is generally conceded. The whole trouble when it comes to disposing of the three or four per cent of tuberculous cattle in Massachusetts or the one per cent more or less of tuberculous cattle in Maine, hinges on the matter of expense. It is human lives in the balance with property, and where it is my property against some one else's life, the property consideration is apt to outweigh human life. There is a disposition to ignore, or make light of the danger and magnify the loss. What is needed is a more general appreciation of the danger, which is certainly real, if not as extreme as the most radical would claim; and the pecuniary loss from the destruction of a few hundred head of sick and comparatively worthless cattle would have little weight. To entirely eradicate human tuberculosis within any given time is impossible. We can't and don't want to use the necessary means; this will be a work of generations and almost entirely along the line of prevention, and the extermination of bovine tuberculosis would be a long step in that direction. But with the means now at our disposal it is perfectly feasible and when rightly viewed I believe it will be considered highly desirable to free this country of human tuberculosis within ten years. We have simply to destroy the comparatively small number of animals that are now diseased, disinfect the places where they are stabled and institute a system of periodical inspection that need be neither cumbersome nor expensive compared to the great end to be gained. Half way measures which simply attempt to control must prove more expensive in the end and not nearly as satisfactory in the results. I know the claim is made that, if all tuberculous cattle were destroyed, it would be but a little time before there would be just as many: but this does not seem to me reasonable. We know that individuals have cleaned tuberculosis out of their herds and kept it out and what is possible for an individual is possible for a community of individuals. The same system of inspection that will enable us to get rid of tuberculosis in the first place will render it possible to keep rid of it. Besides human consumptives will not always be allowed to spread disease broadcast and with all tuberculous cattle destroyed there would be the chief danger to our herds.

Until within very recent years when there has been any attempt to exterminate bovine tuberculosis there has been an insurmountable difficulty in the impossibility of discovering cases until considerable advance had been made. Diseased cattle might remain in a herd for years and their true condition not even be suspected. Although nearly every state has enacted laws for the purpose of controlling or exterminating bovine tuberculosis no apparent headway has been made. There would seem to be as many tuberculous cattle now as ever. To be sure no serious attempt has been made to thoroughly exterminate the disease in any large territory for it has been a recognized impossibility and it is doubtful if the results from the work done have justified the expense, whether they have or not is certainly open to discussion. The destruction of an animal that has already thoroughly infected her surroundings with disease germs and with only a short natural leave of life remaining may be of doubtful importance. She has probably already done most of the harm she is capable of. With the discovery of tuberculin and its effects upon tuberculous cattle we entered upon a new era. What was before so nearly impossible as to discourage effort becomes comparatively easy and it will be strange if during the next ten years we do not see more advance made in getting rid of bovine tuberculosis by the aid of the diagnostic properties of tuberculin than would have been possible in any length of time if dependence had to be placed on a physical examination. In regard to the value of the tuberculin test in diagnosing tuberculosis there can now be no question. The only wonder now is that there should be any opposition to its use or that dependence should longer be placed in a physical examination. But extreme conservatism or ignorance of the comparative value of the tuberculin test probably accounts for it. It is my purpose in this report to review some of the results obtained by the use of tuberculin as compared with a physical examination. Our own experience in the use of tuberculin covers more than three years. We have held autopsies on thirty-two cows, heifers and bulls that reacted under the test, and, although we claim a fair degree of skill in making a physical diagnosis, there were not over ten of these animals that we would have condemned from a physical examination alone,yet with possibly two exceptions they all exhibited tuberculous lesions. In two cases where it was necessary to hold a very hasty autopsy by lantern light no lesions were found. At the state college of Pennsylvania the college herd was given a physical examination, and tested with tuberculin, by two different parties. Only one case of tuberculosis was found by a physical examination, and four by the tuberculin test. One cow that seemed to be tuberculous from a physical examination proved to be suffering from a slight disorder of an entirely different nature. Since last October cattle taken to the Brighton and Watertown markets have been tested with tuberculin by the veterinarian of the Boston Board of Health and destroyed at the owner's loss when found diseased, so it is safe to assume that only apparently sound cattle have been sent there since that time. During the first six months over one hundred animals were condemned and the autopsies showed that 79 per cent were tuberculous, and of sixty-three beef cattle passed as sound and slaughtered, four were found to be tuberculous. Here we have the tuberculin test applied under the most unfavorable conditions upon cattle just arrived from a long journey and surrounded by all the disturbing influences of an open market, yet the result must be considered very favorable to the tuberculin test as compared with any physical examination.

The biologist of the New Jersey Experiment Station, Professor Julius Nelson, reports that of the forty-three animals of the college herd examined by him, reactions were obtained in twenty-eight cases and at the autopsies twenty-five were evidently diseased. The other three, one cow and two heifers were apparently sound but he says the temperature of these three varied so little from the normal that he was in doubt whether they reacted or not, and he killed them on mere suspicion. This same herd was subjected to a careful physical examination before the tuberculin was used and fifteen animals selected as diseased, three of which proved to be sound. Dr. Austin Peters in an address delivered in Boston recently assumes as a result of his observation that only a quarter or a third of the cases of tuberculosis revealed by means of tuberculin would be discovered by a physical examination. Dr. Laws of Cornell, a very conservative man, says in a bulletin published a little more than a year ago. "When the State aims at a thorough extinction of the disease (tuberculosis) in our herds this test (tuberculin test) cannot be omitted as it is absolutely essential to success," and what he says in regard to the extinction of tuberculosis from a state has equal force when applied to a herd.

In regard to the effect of tuberculin upon healthy cattle, in a recent bulletin Dr. Laws produces testimony based upon his own experiments and those of the United States Bureau of Animal Industry that shows, as far as these experiments go that the injection of a test dose of tuberculin into a healthy cow, even if repeated several times, has no appreciable effect upon the productiveness or health of the cow. This has also been the experience of nearly all who have applied the test. Cows that have been tested suffer from the same troubles that affect other cows and there is no ground for connecting these troubles with the test that has been made.

In Bulletin No. 42 of the Vermont Agricultural Experiment Station the history of tuberculosis in the Vermont State College herd is given. The first of January, 1894, all but two animals out of a herd of thirty-three were in apparent health. These two had been in an unthrifty condition since coming from the pasture in the fall; tested with tuberculin twenty-four animals reacted and the post mortem confirmed the test. Two animals that failed to react were killed and showed no disease. In the same bulletin it is stated that the station veterinarian during the first six months of last year made over a thousand injections of tuberculin and two hundred and twenty-two animals were found diseased. Two hundred and twenty of these were slaughtered and found tuberculous. Nothing is said about the other two. This is a very remarkable record and does much to confirm the value of tuberculin in detecting tuberculosis. Most of these cases were found in two badly infected herds and of six hundred and sixty-two animals tested, only thirty-nine cases of tuberculosis were found. In Bulletin No. 27 of the Massachusetts Hatch Experiment Station Dr. J. B. Paige gives the results of his experience with tuberculin. The entire college herd was destroyed at different times, the last of them in January, 1894. At this time thirty-two animals were killed, twenty-five of these reacted under the tuberculin test and were found to be tuberculous. The other seven were sound. Of the twenty-five tuberculous animals in no case had the physical symptoms so developed that by any ordinary examination a diagnosis of tuberculosis could have been made. Among the conclusions with which Dr. Paige closes his bulletin are these:

"The diagnosis of most cases of this disease by physical examination is impossible."

"That in tuberculin we have an exceedingly delicate and reliable test for tuberculosis"

"That in tuberculin we have the only means by which we can eradicate tuberculosis from among our cattle."

We might go on to almost any length in giving the results of the use of tuberculin in detecting diseased cattle, and they would all give testimony in the same line as this already given. Many thousands of cattle have been tested in this and other countries by hundreds of different men and the results have been surprisingly uniform. The most unfavorable results we have been able to find any record of were those obtained by the Boston Board of Health at Brighton and Watertown. We have already noticed the conditions were not such at these places as to warrant us in expecting satisfactory results, but they were in a large measure satisfactory, certainly much better than could have been obtained by a physical examination.

The following is from a bulletin by Dr. E. P. Miles published by the Virginia Agricultural Experiment Station.

"The laws necessary to control the disease (tuberculosis) in bovine animals and lessen the mortality in man may be briefly stated as follows:

1st. The most important of all, the establishment of a state board of health, one member of which shall be a qualified veterinarian.

2d. The appointment of a qualified state veterinarian, who shall be an *ex-officio* member of the State Board of Health and work under its direction.

3d. A liberal appropriation placed at the disposal of these officers, in order that they may effectually carry out their work.

4th. The establishment of public abattoirs, and compelling the slaughter of all animals for meat at these places.

5th. Providing for veterinary inspection of all animals slaughtered for meat; also veterinary inspection of all public dairies.

6th. The provision of some means to compensate owners of all condemned animals.

7th. A law empowering the State veterinarian to order the destruction of all condemned animals.

8th. The provision of county hospitals for indigent tuberculous people.

9th. Compulsory disinfection of all premises that have been occupied by tuberculous people or animals.

10th. Compelling the disposal of the carcasses of all tuberculous animals by cremation.

11th. Prohibiting tuberculous people from attending public gatherings in closed buildings.

With these laws in force, tuberculosis can be practically stamped out.

Science is arrayed for the battle; all that is lacking is the declaration of war on the parts of the states and government."

APPENDIX.

The following report on the prevention of bovine tuberculosis was presented to the Massachusetts Veterinary Association, and after thorough discussion and revision, it was finally adopted by the association at a meeting held on November 28, 1894.

Realizing the importance of preventing the extension and continuance of bovine tuberculosis among our dairy herds, the Massachusetts Veterinary Association has prepared the following brochure in the hope that it may assist in spreading information on the prevention and eradication of this disease.

In referring to tuberculosis the following questions are often asked by stock owners: (1) How shall the occurrence of tuberculosis be prevented in a healthy herd, and (2) how shall tuberculosis be eradicated from a herd that is already diseased?

In considering these questions it should be borne in mind that while it is a fact that, no matter how unhealthy the surroundings, bovine tuberculosis cannot exist without the presence of the bacillus, yet it is equally a fact that the germ requires a suitable soil for its development, and that a favorable condition of the body for the development of tuberculosis frequently results from hereditary predisposition, unsanitary surroundings and the injudicious management to which dairy cattle are so often subjected. It follows then that anything that tends to undermine the health of the dairy stock should be avoided and a continual effort made to strengthen and build up the constitution of the dairy cow.

The following recommendations are made to stock owners to prevent the occurrence of tuberculosis in a healthy herd:

1. As far as possible owners should raise their own stock and endeavor to improve the constitution of the herd by breeding only from animals that are strong constitutionally and known to be free from any tuberculosis taint.

2. When practicable all farmers should own a bull. They should restrict its use to their own cows, and not allow it to come in contact with other stock.

3. Allow no strange animal to come in contact with the herd without first making sure by tuberculin test (which is now recog-

nized to be the only practical method of diagnosis) that they are free from disease.

4. Never buy from infected or suspicious herds.

5. Never purchase a cow with a cough or abnormal breathing, lumpy or diseased udder, swollen joints, or with a tendency to scour or bloat.

6. Overcrowding in barns should be avoided. Provide as much air space as possible, allowing at least 1,000 cubic feet for each animal.

7. Pure air and abundant sunlight are essential to the preservation of health in animals. Windows hinged at the bottom and dropped slightly inward at the top may be utilized for light and ventilation. In this way the air is directed upward, thereby preventing a current of cold air on the cattle.

8. In fair weather cattle should be in the open air as much as possible.

9. All barns should be kept as clean as possible. They should be sprinkled before being swept, and in consequence of the irritating and infectious character of the dust of stables in which tuberculous animals have been kept, sweeping should always be done while the cattle are in the yard.

10. In consequence of the danger to cattle from consumptive expectorating in and around barns, no consumptive person should be allowed to have charge of or come in contact with the dairy cattle.

11. Do not keep manure in the cellar. Better have no cellar, but where one exists it should be well drained, well lighted and well ventilated.

12. Manure should be frequently removed from the neighborhood of barns.

13. The barn yard and its surroundings should be well drained and free from standing water and filth.

14. Early breeding, late and continuous breeding, as well as excessive and injudicious feeding and milking, are all frequent predisposing causes and should be avoided.

With reference to the eradication of the disease in herds already affected, it is recommended that a thorough examination of the herd be made, using tuberculin test.

All animals found diseased should be slaughtered and the remaining animals retested at intervals. The thorough disinfection and renovation of all infected barns is imperative and good drainage, light and ventilation should be secured.

Where these conditions cannot be obtained it would in many cases be more economical and satisfactory to build new stables, always observing the recommendations suggested for healthy herds.

ALEX. BURR, M. D. V.,
JAS. B. PAIGE, D. V. S.,
JOHN M. PARKER, D. V. S.,
Committee on Tuberculosis.

In a bulletin lately published in the United States Bureau of Animal Industry, the following methods of disinfection are recommended:

(a) Corrosive sublimate (mecuric chloride,) one ounce in about eight gallons of water (one-tenth per cent.) The water should be kept in wooden tubs or barrels and the sublimate added to it. The whole must be allowed to stand for twenty-four hours, so as to give the sublimate an opportunity to become entirely dissolved. Since this solution is poisonous it should be kept covered up and well guarded. It may be applied with a broom or mop and used freely in all parts of the stable. Since it loses its virtue in proportion to the amount of dirt present, all manure and other dirt should be first removed and the stables well cleaned before applying the disinfectant. After it has been applied the stable should be kept vacant as long as possible. Before the animals are allowed to return it is best to flush those parts which the animals may reach with their tongues to remove any remaining poison.

APPENDIX.

Bulletins Issued in 1894.

BULLETIN No. 6.

FRUIT CULTURE—VARIETIES.

By far the most important branch of fruit growing in this State is that of orchard culture. Soil and climate seem especially adapted to producing apples of the highest quality and appearance, while rocky hillsides, unfit for the general operations of agriculture, are often found to produce the finest fruit. Pears and plums receive but little attention except in isolated localities, while cherries are still more neglected.

The rapidly increasing number of visitors to our State during the summer months, with the consequent increased demand for fresh fruits and vegetables opens a home market for horticultural products which is very encouraging. It therefore seems advisable that the Experiment Station should obtain and disseminate such information as shall be most helpful in building up the several branches of horticultural work.

As is well known, Maine apples have a world wide reputation for quality and beauty. It remains for us to plant such varieties as are likely to prove most valuable; to give the best possible culture to our orchards; to prevent, so far as possible, the attacks of diseases and insect enemies; and to sort and pack our fruit honestly.

Plum growing, which formerly received considerable attention, especially in the Penobscot valley, is again being undertaken in certain sections of the State. It is a remarkable fact, however, that nearly seventy-five per cent of the plum trees reported in reply to recent inquiries, are grown in Aroostook county. If plum growing can be made profitable in those sections of the State where winter protection of the trees is absolutely essential, there would seem to be no good reason for its neglect in other sections which have equally good soil, far more favorable climate, and more available markets. The most serious enemy of the plum grower is the Black Knot, and it is only by concerted action on the part of growers that this disease can be held in check. In New York and some other important plum growing regions, stringent laws have been passed for the protection of the fruit growers, and it is hoped that in the near future similar action may be taken by our own legislature.

Small fruits, especially currants and gooseberries do not receive the attention their importance demands. Both of the fruits named delight in the cool, moist climate afforded by our high latitude and proximity to the ocean, while they are easy of culture and are always in demand at good prices. Strawberries, too, coming as they do after those from Massachusetts and New York are out of the markets, and just as the people are flocking to our summer resorts, offer a promising field to the enterprising fruit grower.

With the above facts in mind, the subjoined list of varieties (condensed from a catalogue of the fruits of the State which will be published in full in our annual report) is sent out as the first of a series of short bulletins on fruit growing; methods of culture; enemies and diseases of fruits; and the varieties best suited to different sections of the State.

The widely varying conditions existing in different parts of the State render a general statement as to the value of any given variety for the State only approximately correct. Varieties which may be of merit in the southern portions of the State are not sufficiently hardy for the middle and northern counties. On the other hand, some sorts considered specially valuable in Aroostook county, are unknown in York.

The following schedules of varieties for the different sections named, are presented after carefully considering the recommendations of leading fruit growers in those sections:

For Aroostook, Piscataquis, Northern Somerset, Penobscot and Washington counties:

APPLES.—Alexander, Dudley's Winter (North Star,) Fameuse, Hayford Sweet, Oldenburg, Yellow Transparent, Wealthy and the

Hyslop and Lady Elgin Crabs. The number of varieties tried and found wanting would form a much longer list.

PEARS.—Only the most hardy will succeed. Fulton, Eastern Belle, Nickerson, and Vermont Beauty are suggested. Pears have not as yet been grown to any extent.

PLUMS.—Damson, Green Gage, Moore Arctic, Smith's Orleans. Of these, Moore Arctic is by far the most valuable, though not of high quality.

SMALL FRUITS.—Agawam blackberry, Cuthbert and Tyler raspberries; Fay and White Grape currants and the Houghton gooseberry lead.

Many other varieties, both of orchard fruits and of small fruits are under trial for this northern region at the present time, and the results obtained will be reported in due season.

For Oxford, Kennebec, Waldo, and the southern counties:

APPLES.—Baldwin, Ben Davis, Gravenstein, Hubbardston, Jewett Red (Nodhead), Mother, Northern Spy, Oldenburg, Red Astrachan, Rhode Island Greening, Tallman Sweet, Yellow Bellefleur.

PEARS.—Angouleme, Anjou, Bartlett, Clapp's Favorite, Lawrence, Louise Bonne of Jersey, Sheldon.

PLUMS.—Bavay, Imperial Gage, Lombard, McLaughlin.

CHERRIES.—Black Heart, Downer's Late, Governor Wood, Early Richmond, English Morello.

RASPBERRIES.—Cuthbert, Golden Queen, Shaffer, Gregg.

BLACKBERRIES.—Agawam, Snyder.

CURRANTS.—Fay, Versaillaise, Victoria, White Grape.

GOOSEBERRIES.—Downing, Houghton, Smith.

STRAWBERRIES.—Bubach No. 5, Crescent, Haverland, Sharpless, Wilson.

GRAPES.—Concord, Green Mountain, Hartford, Moore's Early, Worden.

The above named varieties are the ones most commonly grown at the present time. It is believed that many of these varieties (especially of the small fruits) will soon be superseded by some of the newer introductions, even as the Hovey strawberry, Knevett raspberry, and Dorchester blackberry have given place respectively to the Crescent, the Cuthbert and the Agawam.

A catalogue of all the varieties known to be cultivated in the State with a concise description and the approximate value of each will be published in our annual report for 1893. A copy of this report will be sent to those requesting the same.

W. M. MUNSON,
Horticulturist.

MAINE STATE COLLEGE,
ORONO, ME., Jan. 8, 1894.

BULLETIN No. 8.

SPRAYING EXPERIMENTS.

Spraying with some solution of copper as a protection from the attack of apple scab is coming to be looked upon as a necessity by many of the more progressive orchardists. During the past three seasons the writer has been engaged in solving some of the problems incident to this work. The results, so far as obtained, have been detailed in the annual reports of the experiment station.*

The principal work of the present season was a comparison of the effectiveness of different mixtures. The failure of certain trees, set apart for that purpose, prevented reaching more definite conclusions regarding the best time for spraying.

The materials used in the work here mentioned, were as follows:

1st. *Modified eau celeste.*—2 lbs. copper sulphate, 2 1-2 lbs. carbonate of soda, 1 1-2 pts. ammonia and thirty-five gallons of water.

2nd. *Bordeaux Mixture.*—6 lbs. copper sulphate (Blue Stone), 4 lbs. fresh lime, dissolved separately, then mixed and diluted to 40 gallons.

3. *Bordeaux Mixture and Paris Green.*—Same as No. 2 with addition of Paris green in the proportion of 1 lb. to 250 gallons.

4th. *Paris Green.*—1 lb. Paris Green in 250 gallons water.

The season was very dry and the trees were much freer from scab than in previous years. That there was marked benefit from the treatment is, however, shown in the accompanying photographs of fruit from contiguous trees and also in the table.

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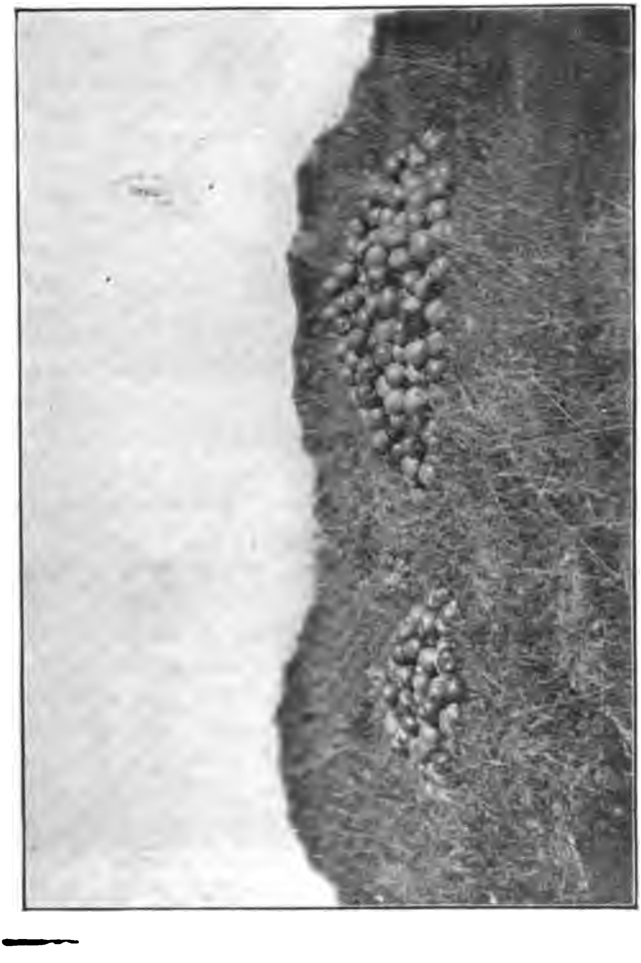
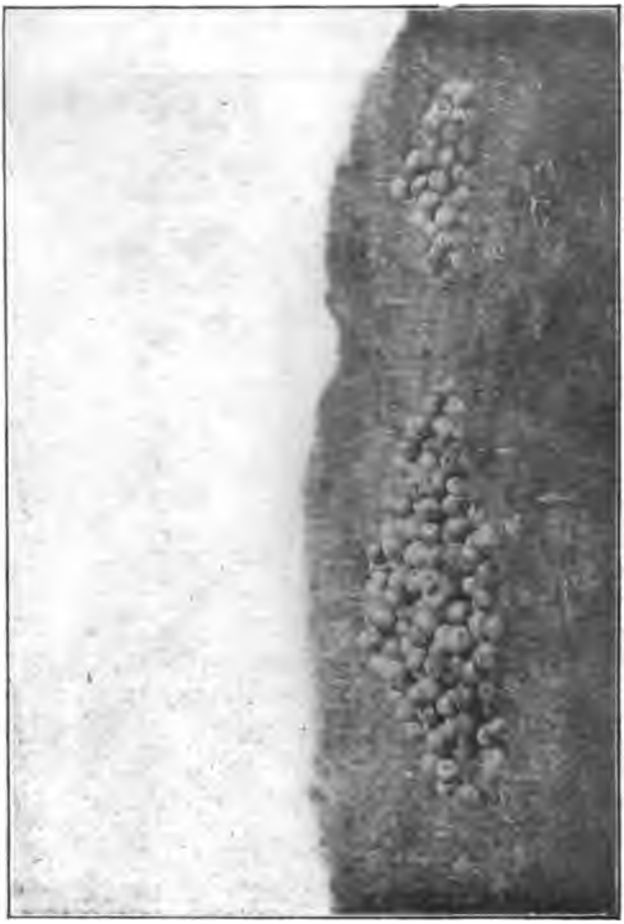
*Rep. Maine Exp. Sta., 1891, p. 112; 1892, p. 92.

NO. 1.—NOT SPRAYED.



Free, 130. Badly scabbed, 17. Slightly scabbed, 582.

No. 2.—SPRAYED.



Free, 474.

Badly scabbed, 3.

Slightly scabbed, 114.

RESULTS OF SPRAYING TO PREVENT APPLE SCAB. 1893.

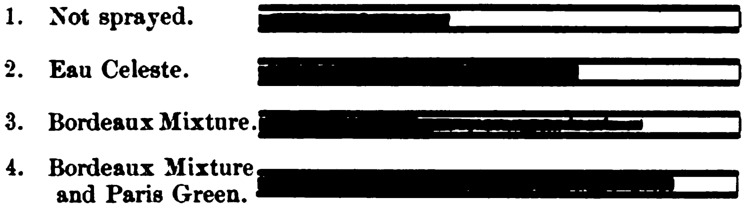
Check trees (not sprayed), -	38.3 per cent. free from scab.
Eau celeste, sprayed four times,	72.8 " " " " "
Bordeaux mixture, sprayed four times, - - - -	79.9 " " " " "
Bordeaux mixture and Paris green, sprayed four times, - -	82.8 " " " " "

The above figures are the average results obtained from an examination of the fruits of three trees of each class. Much of the fruit classed as "slightly scabbed" in our examinations, hence not considered in the above figures, would grade as "No. 1" fruit. As is well known, however, the fungus grows rapidly after the fruit is packed, hence the rigid adherence to our arbitary distinction.

As shown by the table, the best results were obtained from the use of a combination of Bordeaux mixture and Paris green—a fact which would indicate a possible fungicidal value for Paris green. That this value is slight, however, was shown by some trees sprayed with arsenite only.

The modified *eau celeste*, while less effectual than Bordeaux mixture in preventing scab, was also found to injure the foliage unless used with caution. The fruit also was made somewhat rusty, the epidermis apparently being injured by the ammonia.

The relative value of the different materials used may best be illustrated by the following diagram, the shaded portion representing the per cent. of fruit free from scab:



A Brief Retrospect.

For the benefit of those who have not received previous reports, it may be well to give a brief resume of the results obtained from three seasons' experiments.

We have seen that apple scab is caused by a parasitic fungus which attacks the leaves and young twigs as well as the fruit, and that the growth of the tree may be seriously checked. Spraying the trees with certain compounds of copper has been found an effective means of holding the disease in check,—the increase of salable fruit, as a result of spraying, often amounting to 50 per cent.

Indications point strongly to the value of spraying early in the season, before the blossoms open, and of repeating the application four or five times during the season.

The best results have been obtained from the use of Bordeaux Mixture, prepared as follows:

6 pounds copper sulphate (Blue Stone),
4 pounds quick lime,
40 gallons water.

Dissolve the copper in a pail of hot water; slake the lime in another vessel; mix and dilute as above for use.

Farmers are advised to club together in the purchase of apparatus and chemicals, thus reducing expense.

Necessary chemicals may be obtained in large quantities of:

Weeks & Potter Co., Boston.
Eimer & Amend, 205 Third Ave., New York.
W. S. Powell & Co., Baltimore, Md.

Most of the materials may be purchased in small amounts at the local drug store.

Force pumps and other apparatus for spraying may be obtained of any of the leading manufacturers, as:

Field Force Pump Co., Lockport, N. Y.
Gould's Manufacturing Co., Seneca Falls, N. Y.
W. & B. Douglass, Middletown, Conn.

The most satisfactory nozzle we have used is the "McGowen," manufactured by John J. McGowen, Ithaca, N. Y. Our second choice is the "Climax," manufactured by the Nixon Nozzle and Machine Co , Dayton, O.

W. M. MUNSON.

MAINE STATE COLLEGE,
Orono, Me , March 1, 1894.

BULLETIN No. 9.

TOMATOES.

Much of the work with tomatoes during the past season was in continuation of experiments previously undertaken, and related principally to methods of culture. The following condensed notes will indicate in a general way the conclusions reached.

1. *Effect of Early Setting*:—Duplicate lots of plants were given the same treatment early in the season. One lot was removed to the field May 23, the other a week later. The first lot was severely checked by frost May 27, but in spite of this fact the plants recovered and there was practically no difference in the yield of the two lots. The slight variation found, was in favor of the early set plants.

Conclusion:—Indications still point to the value of early setting of tomato plants.

2. *Value of Pot Culture:*—The importance of careful handling of tomato plants has previously been emphasized by the writer. During the past season a test was made as to the value of growing plants in pots previous to setting in the field. Twelve plants of each of four varieties were transferred from the seed flats to thumb-pots, later to 3-inch, and then to 4-inch pots, and to the field June 1st. Duplicate lots were handled in boxes in the ordinary manner on the same dates.

In every instance the plants handled in pots produced a larger number of fruits and a greater total weight of the product than those from boxes; but the individual fruits were slightly smaller.

Computing the yield per acre on the basis of the weight of fruit picked previous to October 1st, and considering the plants placed five feet apart each way, we found for the first three varieties, a difference of more than 29 bushels each, in favor of the pot grown plants. This difference at 75 cts. per bushel, (none of our fruit sold for less than 60 cts. per bushel, and early in the season we received $1.75 at wholesale,) would amount to $21.83 per acre, a sum far in excess of the cost of pots and expense of handling.

Conclusion:—There appears to be a marked increase in the productiveness of plants handled in pots previous to setting in the field.

3. *Individual Variation:*—Very often a new variety is recommended, or a particular method of culture is advocated, because excellent results have been obtained for a single season. The danger of drawing conclusions from such limited experience, was pointed out by the writer last year, when it was found that "in no case were the results from duplicate tests uniform."*

Duplicate lots of each of three varieties of tomatoes were grown during the past season. All of these were given the same treatment in the house, and were planted side by side in the field, receiving the same culture. The results obtained, bear out our former conclusions to such an extent, that the results of certain methods of culture undertaken, are withheld for further verification.

The weight of individual fruits was practically uniform, but the variation in number of fruits, and in the consequent weight of the product, was very marked. The date of ripening was also variable.

Conclusion:—The individual variation of plants of any given variety is often such as to obscure any effects of different methods of culture, and render conclusions drawn from a single season's work very unreliable.

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* Rep. Maine Exp. Sta. 1892, p. 64.

† Rep. Maine Exp. Sta. 1892, p. 65.

4. *Crossing*:—The work of developing a tomato which shall be of sufficient earliness to be profitable as a market crop in those sections where the seasons are short, was detailed in our last annual report.† Selections and further crosses were made the past season with interesting and promising results.

The *Lorillard-Peach* cross showed a less marked increase over the pure Lorillard in number of fruits, than was the case in the first generation. In the second generation, the influence of the male parent on the character of the fruit was shown by several individuals which assumed the form and the rough skin of *Peach*. The *Ignotum-Peach* cross showed a similar falling off in the second generation,—the difference amounting to nearly 44 per cent.

5. *Varieties*:—The tomatoes were started in the forcing house March 27. All varieties were given the same treatment while in the house, and were transferred to the open field June 1st. The first ripe fruits were found July 25, on Golden Ball and Long Keeper. Two days later one or more fruits were gathered from Aristocrat, Great B. B., Ithaca and Maule's Earliest.

On October 1st, when the season was practically ended, the following varieties were found, in the order named, to have been the most productive: Golden Ball, Improved Peach, Maule's Earliest, Burpee's Climax, Lorillard, Ithaca and Belmont. Optimus, which was the most productive sort grown last year, stood *ninth* (or dropping the first two varieties, which are of value for amateur culture only, *seventh*) in the list the present season.

The large late varieties, such as Belmont, Buckeye State and Stone, decayed very badly late in the season. The same is true to a certain extent of Ignotum, Matchless and Optimus.

Maule's Earliest and Burpee's Climax were both much smoother than is usual with very early sorts and are promising.

Ithaca and Long Keeper deserve the credit given in previous reports.

Lemon Blush failed to blush and was consequently inferior to Golden Queen.

Buckeye State, Royal Red and Stone, while of merit as individual fruits, are all too late for our short seasons. Ponderosa will also be discarded for similar reasons.

Terra Cotta was of very unsatisfactory quality and is not a firmly fixed variety.

Great B. B., in spite of its name, is a fairly good variety. It decayed badly late in the season.

SUMMARY OF TOMATO NOTES, 1893.

1. The conclusions of former years as to the value of setting tomato plants as early in the spring as possible are confirmed.

2. Plants handled in pots previous to setting in the field are more vigorous and productive than those not so handled,—a fact which may be of great importance to the commercial grower.

3. Individual variation is often such as to render the work of any one season unreliable.

4. The productiveness of any given variety may be largely increased by crossing with some of the smaller less valuable sorts. But this increased productiveness may be partially or wholy lost in a few years even if good culture is given The variety will quickly "run out."

5. It seems possible that seeds from plants grown under high culture in the house, may give better results than those from plants not so treated.

6. By combining the *Lorillard-Currant* hybrid with the Lorillard, the size has been fully doubled and the quality much improved; but there has been a reduction in the number of fruits produced.

7. Of the newer varieties, Burpee's Climax, Maule's Earliest and "B. B." (Brinton's Best) were among the most promising. Buckeye State, Ponderosa, Royal Red and Stone are too late for our climate. Lemon Blush lacked its distinguishing characteristic, and Terra Cotta was of inferior quality.

W. M. MUNSON.

MAINE STATE COLLEGE,
ORONO, ME., March 15, 1894.

BULLETIN No. 10.

CAULIFLOWERS.

The cauliflower is a vegetable highly prized by many, but is too seldom met with in the home gardens of our State. Possessing many of the good qualities of the cabbage, it is to a certain extent lacking in the peculiar rank flavor which renders the former disagreeable to many people. The delicate qualities of the cauliflower are, however, frequently disguised or lost through failure of the housewife to familiarize herself with the best methods of serving. For this reason we send with this bulletin directions for cooking the cauliflower, condensed from material kindly furnished by Miss Anna Barrows, School of Domestic Science, Boston.*

1. *Culture:*—In a general way the culture is the same as for cabbages. Early varieties should be started in the house or hot bed as soon as the first of April. Handle as needed and set in the open field as early as possible—say the 20th of May, setting the plants about two by three feet.

The best soil is a rich, moist, but well drained loam. Like the cabbage, the cauliflower is a gross feeder and demands intense culture. If growth is stopped, from any cause, the heads are liable to "button," or form small sections interspersed with leaves, worthless for market purposes.

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* *Directions for Cooking the Cauliflower.*—A cabbage or cauliflower, unless taken directly from the garden, is much improved if so placed that it can absorb water through its stalk for 12 to 24 hours before cooking. Soak a cauliflower, head down, in cold salted water for an hour before cooking, to draw out any insects that may be concealed. A small cauliflower may be cooked whole and should be placed in the kettle with the flowerets up, as the stalk needs most thorough cooking. A large head should be divided into six or eight sections. Cook in a kettle of rapidly boiling salted water to which may be added one-fourth of a level teaspoonful of soda, (the soda aids in softening the woody fibre). The kettle should be skimmed occasionally while the vegetable is cooking; or, to save trouble, some prefer tying the cauliflower in a thin cloth. An agate or porcelain lined kettle is preferable to iron, which is likely to discolor the cauliflower. The odor is less noticeable if the kettle is left uncovered; the water may also be changed to dispel the odor. A cauliflower should be tender after twenty to thirty minutes of rapid boiling. If overcooked it appears soggy and water-logged.

A good cauliflower, well cooked, requires little additional flavor besides salt and good butter. Some, however, prefer the addition of grated cheese. The cauliflower may also be served as a garnish for meats, in sauces, soups and is excellent cold as a salad. Many prefer it with a thick cream sauce.

"Cold boiled cauliflower is very good fried plain in butter or breaded and fried, or mashed and fried like oyster plant, with the addition of an egg and a palatable seasoning of salt and pepper."

The last paragraph is from Miss Corson's Practical American Cookery. Many other hints may be obtained from this and other leading guides to cookery.

Frequent cultivation is necessary and it is probable that in case of very dry weather about the time of heading, irrigation would be a profitable means of securing a crop, at least for home use. When the heads are about three inches across, the outer leaves should be brought together and held in place by means of a piece of twine or raffia, that the heads may be well bleached.

2. *Influence of Early Treatment of Plants.*—The question as to the value of handling the plants in pots previous to setting in the open field, was considered with reference to the number of heads produced. Four varieties were used in the test with the following results:

In two instances there was a difference of twenty per cent. in favor of the plants grown in pots. One variety gave the same number of heads in each case, but the plants from pots were two or three weeks earlier than the others. The fourth variety gave a slight difference—about seven per cent.—in favor of the box treatment. Doubtless any benefit that might arise from handling plants in pots would lie in the more uniform rate of growth secured.

Conclusion.—Indications point to an increased percentage of marketable heads as a result of handling cauliflower plants in pots during the early stages of growth.

3. *Effects of Trimming.*—The practice of reducing the amount of foliage at the time of removal to the field received attention the past season. The foliage of one lot of each of five varieties was reduced by one-half, while duplicate lots were left without trimming.

As a rule, the per cent. of heads formed was greater from plants not trimmed. There was practically no difference in the earliness of the two lots, nor was there a marked difference in the size of the heads.

Conclusion.—Results obtained will not warrant us in commending the practice of trimming cauliflower plants severely at time of setting in the field.

4. *Varieties.*—Nearly all of the more important varieties of cauliflower were grown in our gardens the past season for purposes of comparison. As was expected, great variation was found in the different varieties and strains of the same type, as regards

earliness, percentage of heads formed, and the character and quality of the heads.

Nearly all of the earliest varieties produced a high percentage of marketable heads, while the late sorts were anything but satisfactory. Of the whole number of varieties grown, sixteen produced more than seventy-five per cent of marketable heads, while with eight varieties every plant produced a good head. Most of the late varieties were checked by the dry weather and showed a tendency to "button," or go to seed.

The following field notes concerning some of the more important varieties were made:

Alabaster (Johnson & Stokes).—Said to be a sport from *Dwarf Erfurt* (see below). A small, early variety, of erect habit, thus permitting of very close planting.

Autumn Giant (Thorburn).—A very large, late variety of excellent quality. Should not be started so early as most other sorts

Best Early (*Burpee's Best Early*, Burpee) —Small, but one of the earliest and surest heading varieties.

Dwarf Erfurt (Thorburn).—Takes its name from the city of Erfurt, Germany, where cauliflowers are extensively grown. One of the most popular early varieties Several strains were grown the past season, of which the best seemed to be Thorburn's Extra Early.

Early Danish (Farquhar).—Of the Erfurt type; forming a medium sized head, very firm and good. One of the best.

Early Paris (Thorburn, Farquhar).—Moderately vigorous, with long stem and of spreading habit. Leaves covered with heavy bluish white bloom, giving the variety a characteristic light shade. Heads of fair size but lacking in solidity.

Giant Purple (Childs).—A large late variety; very attractive when growing and of excellent flavor, but when served its color is objectionable.

Imperial (Landreth).—A medium sized, pure white variety; of spreading habit, heads not sufficiently firm.

Kronk's Perfection (Farquhar).—A very fine strain of the Erfurt type. Of medium size, early, uniform, and in our plantation was among the best.

Landreth First (Landreth).—Of vigorous, erect habit, but having a short stem. Heads of medium size, white, and rather remarkable for uniformity. One of the best.

Livingston's Earliest (Livingston).—One of the earliest. Small but uniform in date of maturity—a valuable consideration in a market variety.

Long Island Beauty (Gregory). A valuable second early sort. Only two cuttings were necessary, and every plant produced a marketable head.

Prize Earliest (Maule).—Three weeks later than some of the other early sorts. Not satisfactory this season.

Snowball (*Early Snowball*, Thorburn).—A moderately vigorous variety forming small but very solid heads. From this type many valuable strains have been derived. One of the most valuable of these is the next mentioned.

Thorburn Gilt Edge (Thorburn).—Not quite so vigorous as the parent, the leaves being slightly smaller and very dense, while the stem is shorter Heads small but of good form and solid. Usually one of the most reliable.

Vaughan's Danish Snowball (Vaughan).—Differs little from *Snowball* mentioned above. Very early and apparently a sure header.

Algiers, Italian Taranto, Late Dutch, London, Nonpareil, Stadtholder and some others, while producing very good individual heads, were not reliable the past season, but will be given further trial.

SUMMARY.

1. The general treatment of the cauliflower is similar to that required by cabbages. Thorough and frequent cultivation are essential. The outer leaves should be brought together and tied a few days before cutting, that the heads may be well bleached.
2. Handling plants in pots before setting in the field increased the percentage of marketable heads.
3. Trimming plants at time of setting is of doubtful value.
4. Early varieties are, as a rule, more certain to produce a satisfactory crop than are the later sorts.
5. The earliest varieties grown the past season were: Burpee's Best Early, Dwarf Danish, Kronk's Perfection and Livingston's Earliest; closely followed by Alabaster, Landreth's First, Long Island Beauty and several strains of Snowball. All of these varieties produced a high percentage of marketable heads.

W. M. MUNSON.

MAINE STATE COLLEGE,
Orono, Me., April 1, 1894.

BULLETIN No. 11.

CORN AS A SILAGE CROP.

The report of the Station for 1891, pp. 41-46, gives a summary of three years' work in testing the relative production of food material by various fodder and root crops. It appeared that the large variety of corn known as Southern White produced the greatest amount of digestible dry substance per acre, excelling root crops, Hungarian Grass and other varieties of corn. Since 1891 a comparison between varieties of corn has been continued. This has been done because the corn crop is an important one to Maine dairymen and because the problems connected with its growth in Maine are local in their nature and cannot be solved by experiments in other states, excepting possibly New Hampshire and Vermont.

The most common question asked in this connection is, Which are the most profitable varieties to grow, the large, which mature only in a latitude south of New England, or the smaller, which complete their growth in this climate?

As set forth in the report previously mentioned, the proper test of productiveness is the yield of digestible dry matter, the gross weight of crop or even of total dry matter being deceptive because of differences in the water content and in digestibility. All effort has been directed, then, towards ascertaining the actual growth of digestible material in the several cases. One other point has necessarily been considered, viz.: The relative value of a pound of digestible material in the crops compared. This latter comparison can most safely be made by feeding experiments, and this has been the method used.

The study of the corn crop has been conducted in 1892 and 1893 in much the same manner as in previous years, only somewhat more comprehensively. The results secured are concisely stated in the accompanying table, all intermediate data, such as size of plots and yield per plot, being omitted. The figures for the three years previous are stated for the sake of comparison.

COMPARATIVE YIELD OF SOUTHERN CORN AND MAINE FIELD CORN, AS GROWN IN MAINE.

	YIELD PER ACRE.				
	Green corn (whole plant.)	Dry substance.		Digestible dry substance.	
	lbs.	%	lbs.	%	lbs.
Crop of 1889.					
Southern corn.	26,295	12.30	3,234.3	65.	2,102.3
Maine field corn	14,212	17.4	2,472.9	70.	1,720.5
Crop of 1890.					
Southern corn	32,950	14.94	4,922.7	69.	3,396.7
Maine field corn	15,300	15.84	2,415.9	71.	1,715.3
Crop of 1891.					
Southern corn	46,340	13.46	6,237.4	61.	3,804.8
Maine field corn	28,080	13.55	3,804.8	73.	2,777.5
Crop of 1892.					
Southern corn, Field 1	37,320	14.67	5,474.8	64.	3,503.9
Southern corn, Field 2	34,820	14.15	4,927.	64.	3,153.2
Maine field corn, Field 1	22,490	20.90	4,700.	78.	3,666.
Maine field corn, Field 2	29,400	18.64	5,480.	76.	4,164.8
Crop of 1893.					
Southern corn, Field 1	39,066	15.45	6,035.7	65.*	3,923.2
Southern corn, Field 2	26,660	16.58	4,420.2	65.*	2,873.1
Maine field corn, Field 1	27,780	25.43	7,064.4	70.	4,945.
Maine field corn, Field 2	18,610	19.50	3,328.9	70.	2,540.2
Southern corn, 7 trials					
Maximum	46,340	16.58	6,237.4	69.	3,923.2
Minimum	26,295	12.30	3,234.3	61.	2,102.3
Average	34,761	14.50	5,036.	65.	3,251.
Maine field corn, 7 trials					
Maximum	29,400	25.43	7,064.4	78.	4,945.
Minimum	14,212	13.55	2,415.2	70.	1,715.3
Average	22,269	18.75	4,224.	73.	3,076.

* The average of previous years.

The foregoing figures show a large variation in production in different years, under conditions other than the season, quite uniform. This variation is not alone in gross weight of crop, but in dry matter as well. The largest quantity of dry matter produced in any case during the five years is nearly three times that yielded by the smallest crop. This is in part due to manuring and cultivation and in part to the character of the season.

Had these experiments been discontinued after 1891 the outcome would have been decidedly favorable to the large variety of Dent corn, but in 1892 and 1893 the relation of yield has been reversed and the smaller variety of Flint corn has taken the lead. It is probable that another five years' series of comparisons would furnish a somewhat similar experience.

The general outcome for the five years is slightly favorable to the large variety of corn if we consider only the yield of digestible dry matter. But when we take account of the fact that in the one case an average of five and one-half tons more of material have annually been handled over several times, we are led to conclude that the smaller, less watery variety of corn has really proved the more profitable. It is significant, also, that the largest yield of dry matter in any instance has been from the small variety. While the Flint corn grown in this State is not capable of storing so much dry substance as the large varieties of Dent corn, under circumstances equally favorable for both, the latter cannot in this latitude reach anything like maturity, and so loses the advantage of that period when growth is most rapid.

SUMMARY.

(1). The average weight per acre of the green crops for five years were: Southern Corn, 34,761 lbs.; Maine Field Corn, 22,269 lbs.; difference, 11,492 lbs., or nearly five and three-fourths tons.

(2). The average dry matter per hundred pounds was nearly one-third more in the Maine Field Corn, the relation being Southern Corn, 14.50 lbs.; Maine Field Corn, 18.75 lbs., or as 100 : 129.

(3). The Maine Field Corn proved to be the more digestible, the relation for dry matter being: Southern Corn, 65 per cent; Maine Corn, 73 per cent., or as 100 : 112.

(4). The average pounds of digestible dry matter per hundred pounds of green corn have been: Southern Corn, 7.25 lbs.; Maine Field Corn, 13.69 lbs., or as 100 : 189.

(5). The average yield of dry matter per acre has been: Southern Corn, 5,036 lbs.; Maine Field Corn, 4,224 lbs.

(6). The average yield of *digestible* dry matter has been: Southern Corn, 3,251 lbs.; Maine Field Corn, 3,076.

(7). The yield of digestible dry matter has averaged 175 lbs. more with the Southern Corn. To offset this it has been necessary to handle annually five and three-fourths tons more weight.

(8). The largest as well as the smallest yield of digestible matter in a single year has come from the Maine Field Corn.

W. H. JORDAN.

MAINE STATE COLLEGE,
ORONO, ME., April 2, 1894.

BULLETIN No. 12.

POTATOES.

A COMPARISON OF THE TRENCH SYSTEM WITH ORDINARY CULTURE.

A few years ago considerable interest was aroused by the accounts of wonderful yields of potatoes obtained by a method of culture known as the Rural New Yorker trench system. The system derives its name from the fact that it was first used at the trial grounds of the Rural New Yorker and was advocated by the editor of that paper, Mr. E. S. Carman.

The system consists essentially in planting the tubers in trenches five to seven inches deep and twelve to fifteen inches wide, the bottoms of which are well pulverized; covering to the depth of about two inches; then applying any desired amount of fertilizer in the trench, after which the trenches are filled so that the surface shall be level.

Now it has been the practice of the writer for several years to plant in furrows, applying fertilizer broadcast over the surface of the ground; for there is little doubt that the old custom of "hilling" potatoes is worse than useless,—it is positively injurious to the crop on dry soil. It has seemed doubtful in view of the fact that the roots of the potato extend in all directions, filling the whole space between the rows, whether placing the fertilizer in a trench only could be as rational or in practice as satisfactory as the other method.

In the paper referred to and also in a book recently published,* the statement is made that "In every trial the land laid out in trenches, whether with or without fertilizer or manure, has largely outyielded that planted according to the old method of hills or furrows."

In an issue of the Rural New Yorker of recent date is a detailed account of a comparison of the two methods as conducted on the grounds of the originator of the trench system. From this trial the following conclusions were drawn: "There is a difference of the total yield per acre of only one-half bushel (.49) in favor of the trenches but of the marketable potatoes there is a difference of over seventeen bushels per acre in favor of the trenches.

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* The New Potato Culture, p. 35.

"The yield of small potatoes (unmarketable) of the furrows is 16.79 bushels per acre greater than that of the trenches."*

The work of this station, planned without the knowledge that similar work was being undertaken elsewhere, is detailed below.

On a piece of sandy loam, having a southern aspect, alternate rows of the variety named below were planted three and one-half feet apart—one being "trenched," the other planted in an ordinary furrow. The rows trenched were plowed about a foot wide and eight inches deep, after which the soil in the bottom of the furrow was loosened and pulverized, some of the earth being worked back into the furrow. The "seed," cut to two eyes, was then planted one foot apart in the row. The pieces were covered to a depth of about two inches, when a complete fertilizer at the rate of one thousand pounds per acre was scattered in the trenches, and the trenches were filled.

The other rows were simply plowed, the seed pieces dropped and covered, when the same amount of fertilizer as before was scattered on the surface. As soon as the young shoots appeared above the surface a smoothing harrow was used and thorough culture was given until about the middle of July, when the vines covered the ground sufficiently to keep the weeds down and serve as a mulch for themselves.

The comparative results are shown in the accompanying table:

TRENCH SYSTEM VS. ORDINARY CULTURE OF POTATOES.

VARIETY AND SYSTEM.	Weight of product—pounds.	Weight of marketable tubers—pounds.	Weight of small tubers—pounds.	Average number of marketable tubers per hill.	Yield per acre of marketable tubers—bushels.	Yield per acre of small tubers—bushels.
EARLY ROSE.						
No. 1. Furrow	58.87	51.03	7.84	5.6	234.4	34.6
Trench	61.48	53.24	8.24	5.0	244.8	37.9
No. 2. Furrow	80.00	71.00	9.00	6.9	327.7	41.5
Trench	79.23	68.72	10.51	6.1	317.4	48.5
CRANE'S JUNE.						
No. 1. Furrow	69.90	62.00	7.90	6.0	286.2	36.3
Trench	66.30	54.81	11.49	5.2	253.1	52.9
No. 2. Furrow	70.19	58.45	11.74	5.9	269.6	54.1
Trench	71.57	61.04	10.53	5.8	282.1	48.5
HEBRON.						
Furrow	64.15	59.12	5.03	5.4	271.7	23.2
Trench	74.07	65.16	8.91	5.4	300.8	41.1

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*Rural New Yorker, Oct. 14, '93, p. 683.

In every instance duplicate lots produced contradictory results. The first lot of Early Rose gave a greater yield from the trench—the difference being nearly ten bushels of marketable tubers per acre. The second lot reverses these figures, so far as the marketable tubers are concerned, but the increased number of small potatoes makes the total yield practically the same with the two methods of treatment.

The first of Crane's June gave a difference of thirty-three bushels of marketable tubers per acre, in favor of the furrow; while in the second lot the trench produced at the rate of twelve bushels per acre more than the other.

In each instance above mentioned the number of marketable tubers per hill was slightly smaller in the trenches and the weight of individual tubers was somewhat greater. On the other hand, with one exception, the small tubers from the trenches exceeded in weight and number those from the furrow.

Hebron, from the trench was superior to the same variety from the furrow. The number of tubers per hill was the same but the individual tubers from the trench were so much superior as to be equivalent to an excess of twenty-nine bushels per acre over the other.

It will be seen that these facts are, in a measure, opposed to conclusions concerning the system which have heretofore been published. We would not, however, condemn the method without further trial; though it is but just to say that certain parties quoted as obtaining specially marked results from the trench system have discarded this method in general practice.

Conclusion:—It is questionable whether the results obtained will justify the extra labor involved in practicing the trench system of potato culture. In our trials the past season duplicate lots in every instance produced contradictory results.

W. M. MUNSON.

MAINE STATE COLLEGE,
Orono, Me., May 1, 1894.

BULLETIN No. 13.

THE SUPPRESSION OF BOVINE TUBERCULOSIS AND GLANDERS.

The object in writing this bulletin is to call attention to the modern, and, in most cases the only, methods of determining whether animals are suffering from these diseases. But little reference is made to the general symptoms of the diseases, for although volumes might and have been written describing the symptoms that are sometimes noticed, it is a well known fact that in many cases, particularly in tuberculosis, there are no symptoms that would either attract the attention of the owner or that can be detected by the most skillful veterinarian, and in this obscurity lies the chief danger. A long description of inconstant symptoms will tend to obscure the points presented here and would accomplish nothing. Any inquiries regarding diseased animals, accompanied by a description of the symptoms, the Experiment Station will be ready to answer at any time.

Tuberculosis of cattle is a widely distributed disease differing in no very essential particular from tuberculosis of other animals. It is transmitted from sick to well cattle through the matter coughed out and through the milk, and very rarely directly from parent to offspring by inheritance. On account of the conditions under which they are kept, dairy cattle are most subject to the disease and in general it is most prevalent among cattle where consumption and other forms of human tuberculosis most prevail. On the other hand, it seems to be true that human tuberculosis is most prevalent where the meat and milk of tuberculous cattle are used for human food. The statement is made that among some reservation Indians where diseased meat is freely eaten, the death rate from tuberculosis is one-half of all the deaths.

There are two principal reasons why every effort should be made to suppress bovine tuberculosis. 1st: It should be done to protect healthy cattle that are continually being exposed; and 2d: It should be done to save the many thousands of human lives that are yearly sacrificed to consumption contracted and fostered by milk, meat, etc., from tuberculous cattle. It is certainly true that either of these reasons offers grounds sufficient to warrant the adoption of even what may seem to some to be extreme measures to suppress this terrible scourge. If it could be shown that as a state we were entirely free from obvine tuberculosis and sufficient means were being used to preserve that freedom, it would create such a demand for our dairy stock as would compensate us for all the expense involved and we would not be subject in any such measure to the continual losses that we now have to meet from this cause. If any of our breeders have an ambition to improve their stock and go out to purchase animals to this end, they stand about an even chance of ruining their herd and business by introducing tuberculosis with the improved blood. Many instances of this sort might be mentioned as having occurred in this State, and it is safe to say many more will occur unless measures are taken to prevent it. Many of our most progressive dairymen and stock breeders have run against this snag in their business, and have either been obliged to dispose of their stock at a loss to themselves or to those who purchased it, or to continue breeding from diseased stock—a course which deserves to be condemned from every standpoint of policy and safety.

One tuberculous cow introduced into a large dairy herd has often been the means of contaminating most of the herd, and one diseased herd of choice animals where the calves are raised and sold has often been the means of introducing tuberculosis into many herds, to the material loss of the owners. A much more serious reason than the purely financial one why every effort should be made to suppress bovine tuberculosis is the close relation it bears to the same disease in human beings.

Every tuberculous cow is a menace not only to the health of other cattle, but to the lives of human beings. Bovine tuberculosis is not perhaps the greatest factor in causing human tuberculosis, but it is an important factor. It is possible to demonstrate beyond a reasonable doubt that thousands of children and adults die each year as a direct result of bovine tuberculosis. Tuberculosis of cattle and human beings is the same disease, due to the same cause, bacillus tuberculosis. This bacillus thrown off from the lungs of consumptives, coughed out by tuberculous cattle, in the milk of consumptive mothers, or in the milk or flesh of diseased cattle, has the same power to set up disease in susceptible animals without regard to its source. When we consider that during the one year of 1892 in this State alone, 1,513* human beings died from pulmonary and other forms of tuberculosis and that 1892 was probably not an exceptional year in this regard, we ought to awake to the importance of removing the cause of this great fatality as far as possible. This was the year in which grip raged to such an unusual and alarming extent, yet the grip caused less than half (755)* this number of deaths and all other forms of contagious diseases combined did not prove so fatal as tuberculosis.

If the much dreaded disease, small pox or Asiatic cholera, should gain a foothold in our State and for one year cause half the havoc that tuberculosis does every year, the State and nation would combine to use every available means to check it, and they would succeed. Now tuberculosis is a more surely fatal disease than either of these, but just as surely preventable, and, if through long and continuous familiarity with it we had not come to regard its ravages as almost inevitable, we might be comparatively free of it within five years. Dr. Law says "Tuberculosis is allowed to continue its career of death only because of reprehensible ignorance and criminal indifference." (Cornell University, Agricultural Experiment Station, Bulletin No. 65.)

The greatest obstacle to the suppression of bovine tuberculosis next to "criminal indifference" has been the difficulty in determining what animals were affected and what were healthy. We have had no means by which we could detect the early stages of the disease. If a cow were well fed and cared for she might for years be a source of contagion in a herd and a menace to the health of human beings, without her true condition being known. This difficulty in detecting the disease made it practically impossible to get rid of it. The most that could be done was to kill off the advanced cases as soon as they could be detected. Now, however, this is changed. We have a method by which it is possible to detect tuberculosis in cattle in any of its stages with a very high degree of certainty. If there are any cases that cannot be detected by this means, they are either so advanced that the merest novice will have no difficulty in diagnosing them by a physical examination, or, the animals are very slightly affected, the disease for the time being making no progress, so that for practical purposes they can hardly be considered diseased.

In this brief bulletin it is impossible to describe in detail the method by which the diagnosis of tuberculosis in cattle is made easy and certain. It is perhaps sufficient to say that by the simple injection of a twentieth of a gram of tuberculin underneath the skin of a cow there will be a marked rise of temperature within from nine to fifteen hours, provided she has tuberculosis, and not otherwise. Tuberculin, the diagnostic agent, is a chemical substance, that in the dose given has not the slightest injurious effect upon well animals. There are certain precautions to be taken to avoid mistakes, and some degree of skill and familiarity with the diseased conditions of cattle is necessary on the part of one making the test, but with suitable instruments and professional skill it is comparatively easy for one man to examine a herd of fifty animals in less than twenty-four hours and detect every case of tuberculosis that may exist there. Thus we see that the problem of suppressing bovine tuberculosis, we will not say the complete extermination, for this will be impossible while other tuberculous subjects are allowed to freely distribute the seeds of disease, resolves itself into the simple testing of all bovines with tuberculin; and as soon as the public mind is awakened to the true importance of the work this will be done, and the tests will be repeated sufficiently often to keep the disease in check. Public sentiment that will demand the suppression of what has long been regarded as an inevitable evil may be slowly developed, but its development is sure when the work to be accomplished is so simple and important as the suppression of tuberculosis.

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*Report of State Board of Health for 1893.

But if radical and generally applicable measures are not at once in operation to do away with this disease, there is no reason why individuals should not protect their own herds and the lives of their families and patrons by making sure that they are not harboring it. A man who will buy and keep a family cow to supply milk and butter for his children and not adopt the simple and inexpensive measures necessary to be sure she is not affected with tuberculosis is either ignorant of the danger incurred or guilty of negligence little short of criminal. The dairy man who is supplying the public. including invalids and children, who are particularly susceptible to consumption, with milk or butter, who will not go to the slight expense necessary to test his herd for tuberculosis, has neither a proper regard for his own or patrons' interest; and, particularly, the breeder of choice dairy stock that will continue to breed and distribute among other herds cattle that may, and, as experience has shown, are particularly liable to carry with them the seeds of tuberculosis, is not deserving of public confidence. Any one can purchase tuberculin from some of the leading druggists and also the necessary instruments with which to administer it, but we would advise the average farmer and stock owner not to undertake a test of this importance, the complete success of which depends upon experience and professional skill. It would be better to employ a competent veterinary surgeon. The expense ought not to be very great. For the present, as far as other work will permit, the Experiment Station will undertake to examine cattle for tuberculosis in any part of the State where the owner will pay travelling expenses. We cannot promise to continue to do this indefinitely, but for the next few months, for the purpose of obtaining data relative to the prevalence of tuberculosis among our cattle, we hope to be able to answer all calls in this direction. It is possible that arrangements can be made to examine a limited number of large herds free of all expense to the owner. After a herd is once free from tuberculosis, we can only be sure of keeping it free by attention to the following details:

1st. Have the barn thoroughly disinfected. 2nd. Retest the herd at intervals. 3rd. Test all purchased animals before adding them to the herd.

GLANDERS.

This is a disease prevailing among horses and mules, and transmitted from them to some other domestic animals and to man. Cattle are not subject to it. In a very general way it bears some resemblance to tuberculosis. Its presence has often been difficult and even impossible to determine. Horses are sometimes affected with it for years, and carry the disease to other horses without manifesting any symptoms that lay them open to suspicion. The disease is conveyed to man and other animals brought into contact with the diseased one chiefly through the nasal discharges and from ulcerating lymphatic glands. Recoveries from glanders are probably less frequent than from tuberculosis, and when transmitted to human beings it usually assumes an acute and speedily fatal form. The glanders bacillus is the active source of this disease and this bacillus is given off from diseased animals, chiefly in the nasal discharge and in the discharge from the ulcerated lympathic glands Well animals contract the disease by introducing into their systems in some way the glanders bacilli contained in these discharges. The disease is most prevalent where large numbers of horses and mules are found closely associated in confinement. Here the conditions are most favorable for the spread of the disease, but as horses circulate quite freely from city to country districts, public watering troughs and feed stables where transient boarders are kept also have their share in spreading the disease. Through this State cases are continually appearing in such advanced condition that they cannot be mistaken for anything else and they are killed How many other affected animals escape detection and are not even suspected of being glandered, nobody can tell, but it must be a considerable number. In any suspected case or in the case of any animal where it is desired to know positively whether the horse is suffering from glanders we now have a sure test similar in nature to that by which we determine the presence of tuberculosis. A very small quantity of a chemical substance called mallein injected into a glandered horse causes a rise of temperature and a local swelling at the point of the injection, while if the horse is sound the small dose of the mallein used apparently has no effect. The discovery of the value of mallein in diagnosing glanders followed soon after the discovery of tuberculin, and while of less importance, is nevertheless of great value. In stables where one horse among many is found to have glanders we can with mallein make sure that no obscure cases are allowed to remain. By this test prized family horses suspected of having glanders can often be shown to be free of it, and none of the wiles of the tricky dealer will be able to disguise glanders so that this test well made will not reveal it.

SUMMARY.

1. This bulletin is for the purpose of calling attention to a satisfactory method of determining the presence of tuberculosis in cattle and glanders in horses.
2. Tuberculosis is a widely distributed disease common to man and other animals and readily transmitted from one to the other.
3. Tuberculosis is spread among cattle and from cattle to man by the material coughed out from the lungs and by the milk and flesh of affected cattle.
4. Bovine tuberculosis should be suppressed as a measure of economy and to prevent sacrifice of human lives.
5. By a physical examination tuberculosis in cattle can only be detected in advanced stages.

6. By means of tuberculin it can be readily detected in all stages.

7. The tuberculin test is simple, harmless and conclusive and should be used to test all cattle in the State and all imported animals before they are introduced into new herds.

8. The Experiment Station will for a time undertake to test cattle for any who may desire, at the simple cost of traveling expenses.

9. Glanders is often an obscure disease with no well marked symptoms.

10. Glanders may be transmitted from affected horses and mules to man by means of the discharge from the nostrils or from ulcerated lymphatic glands.

11. Glanders is most prevalent in large cities but is often conveyed by the sale of affected horses into country towns.

12. Mallein serves as a sure test of the presence of glanders.

13. Mallein can be used with no risk and slight expense.

F. L. RUSSELL.

MAINE STATE COLLEGE,
Orono, Me., June 1, 1894

BULLETIN No. 15.

A SCHEME FOR PAYING FOR CREAM BY THE BABCOCK TEST IN BUTTER FACTORIES.

J. M. BARTLETT.

Several of the butter factories in this State are already employing this test to determine the butter value of the cream furnished by their patrons and are making use of those values as a basis of payment. In some cases considerable confusion and dissatisfaction have arisen between the patrons and managers of the factories, due in some cases to a misunderstanding on the part of the former and in some few instances to an improper handling of the test on the part of the latter. We feel it our duty to state here that no person should even attempt to employ the test as a basis of payment until he has thoroughly mastered it and has convinced himself that he can obtain correct results. It would be better in all cases if he could secure instruction from some person competent to give it, than to try to work it out by himself.

Another and the principal cause of confusion and misunderstanding has been the many systems employed by the different factories for applying the test in a practical way, and as it is evident that this will soon be the universal method of paying for cream and milk it seems absolutely essential that some good and uniform system should be adopted.

The object of this bulletin therefore, is to present what we consider the best system for this important work and which is, practically, the one in general use in milk gathering creameries. In this system the cream is to be bought by weight as we believe it simpler, more accurate and just as rapid to weigh with one of the spring scales which can be found in most hardware stores, than to measure by any system now in use.

APPARATUS FOR SAMPLING AND WEIGHING.

Pail for Weighing.—For this purpose we would suggest a light pail not more than nine or ten inches in diameter and eighteen to twenty inches deep, having a strong bail, a lip or nose on the top and handle near the bottom to assist in emptying. It should be made of light material and strengthened at the top by a hoop to avoid denting when being emptied and should weigh five pounds.

This will hold easily fifty pounds of cream, which is as much as the collector cares to handle.

Scale for Weighing —There are several spring scales on the market that doubtless are good for this purpose, but the best we have seen is a Chatillon spring scale that has a dial and will weigh up to sixty pounds.

The indicator can be set back so it will stand at zero when the pail is attached. The figures to which it points after the cream is put in will be the weight of the cream.

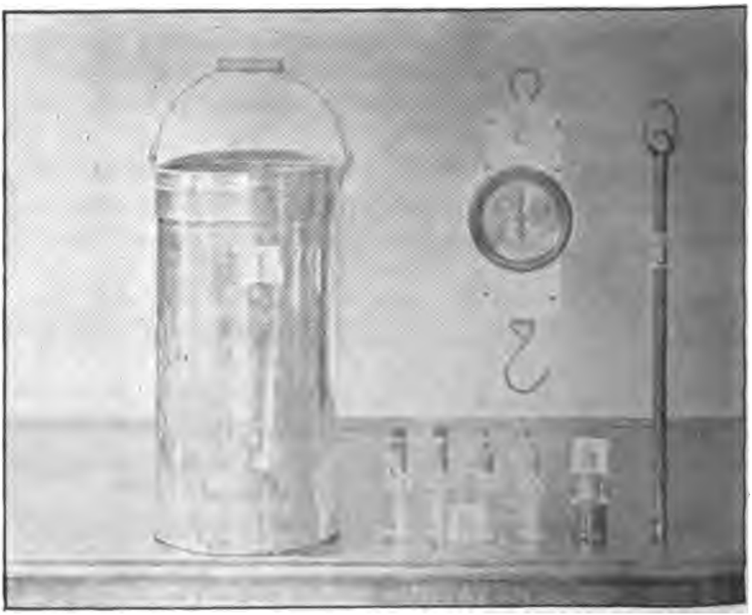
This scale is compact and can be carried in a box eight by fifteen inches In making the weighing, it can be hung on a support on the back of the collector's wagon or on a hook in the dairy that is high enough to allow the pail to hang clear.

Tube for Taking the Sample.—For this purpose we would recom mend a metal tube about two feet long and five-sixteenths inch inside diameter, provided with a stopper at the lower opening that can be worked at the top by a small rod running down through the large tube.

Bottle for Carrying the Sample.—We prefer a two-ounce, wide mouthed bottle, made of strong glass and provided with a cork stopper. A case should be provided for these bottle with pockets to prevent them from rattling around, and a closely fitting cover to protect them from cold weather in winter. Each bottle should be given the number of the patron for whom it is to be used.

SAMPLING FOR THE TEST.

Manipulation.—After the cream has been turned into the weighing pail, the sample is taken by letting the sampling tube, with the lower end open, *slowly* down to the bottom of the pail. The lower opening is then closed, the tube taken out, allowed to drain a moment and the contents run into the bottle marked with the patron's number. It is very essential that this tube be let down slowly and that the lower end be open, so it will fill as it goes down, taking a section of the cream through the whole column and insuring a correct sample. If the tube is let down quickly, or with the lower end closed, and then allowed to fill from



COLLECTOR'S OUTFIT.

1. Pail for weighing. 2. Scale. 3. Sampling tube. 4. Sample bottles. 5. Preservative (bichromate of potash).

the bottom of the pail, it is possible to get a sample much less rich in fat than the top would yield. If there is more than one pail of cream, a portion should be taken from each and every lot weighed out. If a tube full from every lot more than fills the sample bottle, then all the portions drawn should be mixed in a dish large enough to hold them and the bottle filled from the mixture. In any case enough should be taken to fill the sample bottle to prevent churning on the road.

Preservative.—For this purpose we would recommend bichromate of potash. After the sampling bottles are thoroughly cleaned with hot water and washing soda, a small amount, about what can be held on one-quarter inch of the blade of a penknife, of the finely powdered bichromate of potash should be put in each bottle before starting out to collect cream, then if the cream is perfectly sweet and well shaken up after being put in the bottle, it will keep sweet two weeks if kept in a cool place. Cream that is sour should not be sampled, as it is impossible for a collector to get a fair sample of it in any reasonable length of time. If it has become thick it cannot be mixed by the collector so it will be uniform, and cannot be sampled with the tube. Creamery managers should insist that their patrons keep their cream sweet until it is taken by the collector. This is essential not only to correct sampling, but to making a good quality of butter.

Composite Sample.—The composite sample is made up from the small samples taken by the collector and is the one from which the portion is taken for the test. Half-pint fruit jars are good receptacles in which to put these samples, and each one should be numbered with the patron's number, the same as the small bottles used by the collector.

The small samples are taken every time cream is collected according to the directions previously given, and as soon as they arrive at the factory they are emptied into the fruit jars having corresponding numbers. The jar should be closed tightly to prevent evaporation. At the end of two weeks, if one chooses to test as often as that, these accumulated small samples constitute the composite sample and the per cent of butter fat found in this sample will be the average per cent in all the cream furnished by the patron having that number for that period.

In winter, or if the composite sample be kept in an ice chest with the preservative, it could be kept four weeks as easily as two, thereby reducing the work of testing one-half.

Paying for the Cream.—The majority of our creameries in this State are co-operative and therefore the profits are divided among the patrons in proportion to the amount of butter fat furnished. With this class of creameries the simplest method of dividing profits is as follows, and is best presented by an illustration:

Suppose we have a creamery with A, B and C as patrons.

A furnishes for one month 400 lbs. cream testing 20% butter fat.
B " " " " 500 " " " 18% " "
C " " " " 600 " " " 15% " "

Then A furnishes 400 × .20 = 80 lbs. butter fat.
" B " 500 × .18 = 90 " " "
" C " 600 × .15 = 90 " " "
Total received, 260 " " "

The net profits from the sale of butter and cream for the month are $70.

Then A is entitled to $\frac{80}{260}$ of $70 = 21.53\frac{1}{13}$.
" B " " " $\frac{90}{260}$ " $70 = 24.23\frac{1}{13}$.
" C " " " $\frac{90}{260}$ " $70 = 24.23\frac{1}{13}$.

In case the creamery is not co-operative and the proprietor wishes to fix a price for the cream according to the market price for butter, then all that is necessary is to fix the price for the butter fat. Good creamery butter should on the average contain 83 per cent of butter fat, then if butter is 20 cents per pound, butter fat would be worth 24.1 cents which is calculated by the following proportion:

83 : 100 : : price of butter : price of butter fat.
83 : 100 : : 20 cents : 24.1 cents.

When the cream is weighed and the per cent of butter fat determined the value of the cream is very easily calculated and the process should be readily understood by everyone. The product of the weight of the cream multiplied by the per cent of fat will be the weight of the fat and this product multiplied by the price of fat per pound will be the value of the cream.

BULLETIN No. 16.

INVESTIGATION ON THE FORAGING POWERS OF SOME AGRICULTURAL PLANTS FOR PHOSPHORIC ACID.*

PROF. WALTER BALENTINE.

Of recent investigations in plant nutrition those establishing the fact that leguminous plants are able to gather a portion of their nitrogen either directly or indirectly from the free nitrogen of the air are by far the most important, both from the scientific and the practical stand points.

These investigations settle a question that has attracted the attention of agricultural chemists for half a century. On the practical side the results enable us to say, that it is possible, by growing and feeding to farm animals such plants as peas and clover, to increase the stock of nitrogen for manurial purposes without resorting to the various expensive commercial nitrogenous materials.

Stating the results of these investigations concisely, it has been found that the leguminous plants are able to forage on the atmosphere for a portion of their nitrogen. Other plants either possess this power to a much less degree or not at all. If we look for a reason why this family of plants has attracted so much attention from scientists we find it in the fact that some of its members, the clovers especially, have been found in practical farming to be plants which by their growth on the soil, apparently leave it richer in plant food than before, and that farmers are actually able to produce more of grass, grain and potatoes when clover is used as one of the crops in rotation. It was to learn why a plant that takes up such large quantities of nitrogen as clover, should still leave the ground in a better condition for succeeding crops, that the sources of supply of nitrogen to the leguminous plants have been so carefully studied.

The value of the results of this work to the agriculture of the world cannot be over-estimated. There are, however, other problems in plant nutrition which deserve as careful study as the nitrogen question and which may yield results of equal practical importance.

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*This bulletin is an extract from the report of Prof. Balentine in the Station report for 1893.—W. H. J.

All who have given especial attention to the subject of plant nutrition will, undoubtedly, agree that the foraging powers of plants for the elements contained in the ash, vary greatly. This fact is recognized by the majority of observing farmers, as is shown by the following common sayings: "Wheat requires a rich soil." "Corn is a gross feeder." "Oats are an exhaustive crop."

Notwithstanding that these views regarding the variation in foraging powers of different crops have been held by many for years, no one is prepared to say just how it is exerted. We are hardly ready to express an opinion whether the greater vigor of certain plants as compared to other species grown on the same soil is due to their superior foraging powers for all of the elements contained in their ash, or for one or more particular elements.

It seems quite as likely, however, that some plants are able to use certain soil compounds of potash or phosphoric acid, which are not available to other plants, as it did that the legumes were able to obtain nitrogen from sources that were not available to the grasses.

Believing that a study of the foraging powers of different agricultural plants would reveal facts of scientific interest, and at the same time of practical value to agriculture, the writer commenced a series of experiments, in the fall of 1892, designed to test the readiness with which different plants obtain their phosphoric acid from insoluble phosphates.

The reason why phosphoric acid was selected on which to make these first studies, in preference to any other substance was, that in practical manuring with crude phosphates, and also in their use in experimental work, different crops had apparently showed decided differences in their abilities to gather phosphoric acid from such a source.

EXPERIMENTAL METHODS.

In order to have the work as much as possible under control the experiments were conducted in boxes in the college forcing house. These boxes were of wood, fifteen inches square and twelve inches deep. For soil a fine sand was used, taken from a sand bank about three feet below the surface. This sand was drawn to the forcing house, screened and thoroughly mixed by repeatedly shoveling it over, after which a sample was taken and the contents of potash and phosphoric acid determined, with the following result: Potash, 0.096; phosphoric acid, 0.012 per cent.

One hundred and twenty pounds of sand were used in each box.

For each kind of plant studied nine boxes were used, in three sets of three boxes each.

The three boxes of each set received the following manuring per box:

SET I	8.5 grams nitrate of soda = 1.36 grams nitrogen. 2.6 grams muriate of potash = 1.36 grams potash.
SET II	8.5 grams nitrate of soda = 1.36 grams nitrogen. 2.6 grams muriate of potash = 2.36 grams potash. 17.0 grams South Carolina rock = 4.35 grams insoluble phosphoric acid.
SET III	8.5 grams nitrate of soda = 1.36 grams nitrogen. 2.6 grams muriate of potash = 1.36 grams potash. 28.5 grams acidulated South Carolina rock = 4.46 grams phosphoric acid, three-fourths water-soluble.

It will be seen that all of the boxes were treated alike with reference to potash and nitrogen, that the plants grown in Set I were dependent on the phosphoric acid originally in the sand, that those grown in Set II had in addition 4.32 grams of phosphoric acid, mostly insoluble, supplied by crude finely ground South Carolina rock, and that those grown in the boxes of Set III had in addition to that originally contained in the sand 4.46 grams of phosphoric acid, mostly soluble, supplied in acidulated South Carolina rock.

The plants thus far studied have been wheat, barley, corn, beans, peas, potatoes and turnips.

After planting, the boxes were under the care of a man experienced in growing plants under glass. Water was supplied as it was believed to be needed. At the proper time the plants were thinned so that the boxes having the same kind of plants contained the same number of plants to the box.

The plants were allowed to grow to maturity. Immediately before harvesting, the crops were photographed and plates made showing the relative development of the plants produced. At the time of harvesting, the crops of wheat, barley, corn, peas and beans produced in each box were wieghed separately in an air dry condition, after which the amount of dry matter was determined in the combined crop of the three boxes of each set.

	Dry matter produced in each set of three boxes.						
	Wheat.	Barley.	Corn.	Beans.	Peas.	Potatoes.	Turnips.
	grams.	grams.	grams.	grams.	grams.	grams.	grams.
Only soil phosphoric acid....	76.9	201.5	39.5	15.7	112.7	113.3	154.4
Water-insoluble phosphoric acid	148.6	294.9	108.3	17.4	196.7	114.6	304.1
Mostly water-soluble phosphoric acid.......	296.3	508.1	291.0	69.8	228.6	223.7	270.4

While it may not be desirable to draw definite conclusions from so small an amount of data as is furnished by the above described experiments, there are some points which under the conditions of these experiments the results appear to bring out sharply.

1st. Different crops showed a decided difference in their powers of obtaining phosphoric acid from crude, finely ground South Carolina rock. Wheat, barley, corn, peas and turnips apparently appropriated the insoluble phosphoric acid from this source with greater or less ease, while beans and potatoes derived no benefit from it.

2d. The greatest practical advantage derived from the use of find ground South Carolina rock was with the turnips. With this crop a larger weight of dry matter and also a larger weight of fresh roots was obtained with insoluble phosphoric acid from the finely ground South Carolina rock than with an equal amount of soluble phosphoric acid from acidulated South Carolina rock.

3d. The indications point to a profitable use of finely ground South Carolina rock as a manure for barley and peas, as well as turnips.

4th. The acidulated Soute Carolina rock in these experiments apparently depressed the yield of grain with barley, while largely increasing the amount of straw. With wheat, both grain and straw were largely increased and in about the same proportion.

MAINE STATE COLLEGE,
ORONO, ME., Nov. 1, 1894.

NOTE. These investigations are being continued and will be kept up, if possible, until the results warrant definite conclusions. Additional data are already obtained and experiments are now in progress. W. H. J.

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BOTANICAL LABORATORY
UNIVERSITY OF VERMONT

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ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

FOR THE

YEAR 1895

PART II

Report of the Director of the Agricultural
Experiment Station.

ANNUAL REPORT

OF THE

MAINE STATE COLLEGE

FOR THE

YEAR 1895

PART II

Report of the Director of the Agricultural Experiment Station.

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TREASURER'S REPORT.

Maine State College Agricultural Experiment Station in account with the United States appropriation, 1894–5:

Dr.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1895, as per act of Congress approved March 2, 1887	$15,000 00

Cr.

By salaries:		
(a) Director and administration officers	$1,705 84	
(b) Scientific staff	5,922 74	
(c) Assistant to scientific staff	1,708 35	
(d) Special and temporary services	221 00	
Total		$9,557 93
Labor:		
(a) Monthly employes	$164 62	
(c) Hourly	601 03	
Total		765 65
Publications:		
(a) For printing	$145 50	
(c) For envelopes for bulletins and reports	45 00	
(d) Other expenses	17 60	
Total		208 10
Postage and stationery		275 67
Freight and express		180 97
Heat, light and water:		
(a) Heat	$312 44	
(c) Water	100 00	
Total		412 44
Chemical supplies:		
(a) Chemicals	$106 56	
(b) Other supplies	179 55	
Total		286 11

Seeds, plants, and sundry supplies:		
(a) Agricultural	$ 44 85	
(b) Horticultural	451 78	
(c) Botanical	15 92	
(d) Entomological	19 25	
Total		$531 80
Fertilizers		167 65
Feeding stuffs		508 03
Library		111 13
Tools, implements, and machinery:		
(b) New purchases		185 31
Furniture and fixtures		118 85
Scientific apparatus		417 78
Live stock:		
(b) Cattle	$150 00	
Total		$150 00
Traveling expenses:		
(a) In supervision of Station work	$121 99	
(b) In attending various meetings	92 86	
Total		214 85
Contingent expenses		209 31
Building and repairs:		
(a) New buildings	$458 41	
(b) Improvements	96 92	
(c) Repairs	193 61	
Total		748 94
Totals		$15,000 00

REPORT OF DIRECTOR.

A. W. Harris, Ph. D., President Maine State College:

SIR:—I submit herewith a report of the work of the Maine Experiment Station for the year 1895.

It is gratifying to note that the scope and influence of the work of the station are increasing yearly. This is caused in part by new legislation affecting the station and in part by the fact that scientific appliances and information are becoming more and more a necessary factor of successful agriculture. Not only are the difficult questions of current agriclutural practice largely referred to science for an answer,rather than to popular beliefs as formerly was the case, but there is a pressing demand that the boundaries of knowledge be enlarged in matters pertaining to agriculture. Besides, the scientist, especially the chemist, is now being charged with the execution of laws affecting the farmer's interests. In all these directions the Maine Station has been more or less active.

FERTILIZER INSPECTION.

As has been stated in previous reports, it has been found that an analysis fee of $15 for each brand of fertilizer sold in the State to the extent of thirty tons or more is not sufficient to pay the expenses involved in an official inspection according to the terms of the law. Accordingly the legislature of 1895 was asked to so amend the law that the analysis fee should be $20 for each brand sold to the extent of ten tons or more.

The change in the analysis fee was secured, but through a clerical or other error, the thirty ton limit was retained. It now appears that the receipts from analysis fees will just about cover the proper expenses of a painstaking execution of the law. The indications are at this time that more brands of fertilizers will be sold in 1896 than ever before. Old companies are increasing the number of brands they are offering and new companies are entering the State. Confusion is being added to confusion, and the day of a rational fertilizer trade appears to be as far away as ever. The number of brands paying a fee for 1896 probably will not be far from eighty, while the brands offered for sale in the State will undoubtedly considerably exceed one hundred. This means that perhaps thirty brands are exempted from the payment of the analysis fee as coming within the thirty ton limit. The terms of the law require, however, that these non paying brands shall be inspected, consequently it is possible for a manufacturer, by selling a small amount of a large number of brands, to augment the work of inspection entirely out of proportion to the analyses fees paid. The text of the fertilizer may be found in this report.

THE INSPECTION OF CHEMICAL GLASS WARE IN CREAMERIES.

The bill introduced into the last legislature by Hon. Z. A. Gilbert, chairman of the committee on agriculture, requiring for one thing an inspection of the graduated glass ware used by creameries in determining the fat content of milk and cream, became a law. The director of this station is charged with the execution of this part of the law, either by himself or by some one he may designate.

Mr. J. M. Bartlett, one of the station chemists, was named to attend to this duty.

There has been very generally a disposition manifested on the part of creamery managers to comply with the terms of the law. The results so far reached justify the existence of the law, and testify to the wisdom of its promoters. The text of the law is printed herewith.

INVESTIGATIONS IN HUMAN NUTRITION.

Acting upon recommendations made by Secretary Morton in 1893 Congress subsequently appropriated $10,000, to be used in making investigations in human nutrition. Professor W. O. Atwater of Wesleyan University, Middletown, Conn., was placed in the immediate charge of the expenditure of this fund and it may properly be considered a matter for congratulation that he regarded the Maine Experiment Station so favorably as to entrust to it a portion of this money to be used in conducting investigations.

Mr. F. C. Moulton, a graduate of the Maine State College, was engaged as an assistant to aid in this line of inquiry. Work was begun in February 1895 and has been industriously and faithfully prosecuted throughout the year, its object being to study the effect of the source of the food supply upon the amount and cost of the food consumed in the college boarding house, especial attention being given to the influence of an abundant supply of milk upon the amount and cost of the dietary.

The results reached indicate in general that the free use of milk does not increase food consumption and cheapens the cost of raw materials.

THE RESULTS FOR THE YEAR.

The principal features of this report are the following: The result of an important study in plant nutrition, covering the work of two years, this being an attempt to learn something about the feeding capactiy of certain families and species of plants; an investigation into the influence of the ration upon the growth and composition of the animal body; experiments in feeding milch cows with a variety of foods, especially a silage corresponding to the Robertson Mixture; horticultural experiments; and a report concerning certain injurious insects and fungi, part of which consists of original observations on the life history of a Trypeta which is doing much damage to currants in the vicinity of Orono.

Owing to the absence of Professor Munson, the horticultural work has been less in 1895 than in previous years.

The activities of the station have been directed largely towards either the verification of existing beliefs or the discovery of new facts, and in so doing the station has certainly exercised its true function.

The director of the station feels that he should express his sincere appreciation of the faithful and loyal co-operation of his associates in prosecuting the work committed to their care.

W. H. JORDAN, DIRECTOR.

MAINE STATE COLLEGE,
ORONO, ME., December 31, 1895.

INVESTIGATION ON THE FORAGING POWERS OF SOME AGRICULTURAL PLANTS FOR PHOSPHORIC ACID.

L. H. MERRILL.

Several years ago Professor Balentine, then agriculturist of this station, began a series of experiments for the purpose of determining the "foraging power" of certain plants for phosphoric acid. The results then obtained were published in the annual report of this station for 1893.

These investigations were considered of such importance that after Professor Balentine's death the work was extended and continued. Eight species of plants were chosen, representing four orders: peas and clover (Leguminosae); turnips and ruta bagas (Cruciferae); barley and corn (Gramineae;) tomatoes and potatoes (Solanaceae). The plants were grown in the forcing house in wooden boxes, fourteen inches square and twelve inches deep, each containing 120 pounds of sand. This sand was obtained from a knoll near by, and having been taken from a depth of three or four feet was nearly free from organic matter. It was found to contain a very little phosphoric acid, but the total amount present was so far below what would be required by a vigorous plant that it is doubtful if its presence could be considered a disturbing factor. Owing to its almost complete inertness and its inability to puddle or pack, this soil has proved a very satisfactory medium, and was thought preferable to the mixture of sphagnum and coal ashes sometimes used in pot experiments.

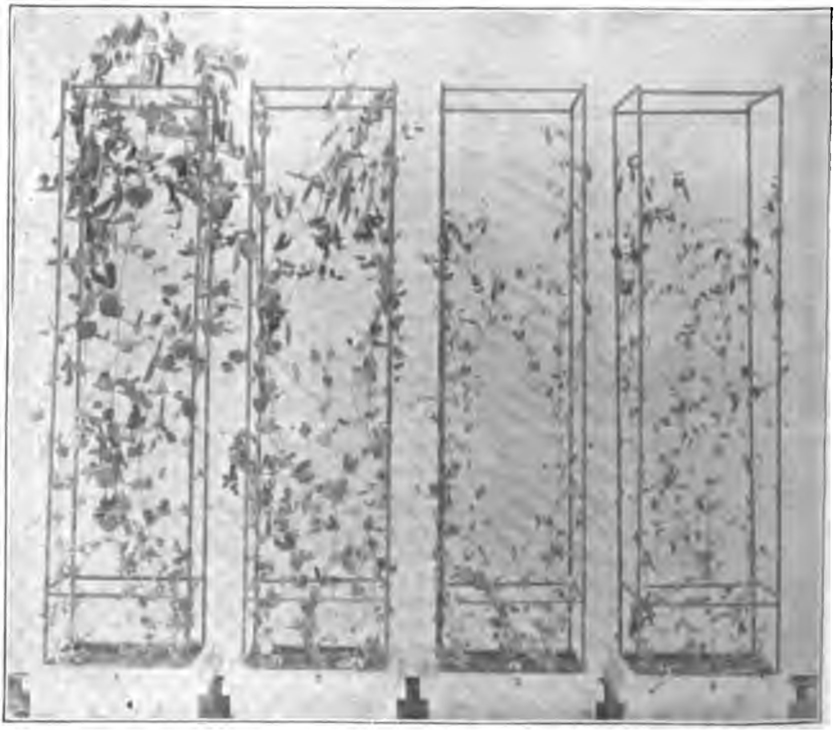
Three forms of phosphates were used:

A. Acidulated Florida rock, containing 20.60 per cent. total phosphoric acid; 14.97 per cent. soluble; 3.70 per cent. insoluble; 16.90 per cent. "available."

B. Crude, finely ground Florida rock (Floats,) containing 32.88 per cent. phosphoric acid. This was obtained from the commercial ground rock by stirring it with water, allowing the coarser particles to subside and then pouring off the turbid water. The "Floats" are the sediments deposited from these washings.

C. A phosphate of iron and alumina, containing 49.58 per cent. phosphoric acid, a large part of which, 42.77 per cent., was soluble in ammonium citrate. This ready solubility in ammonium citrate is brought about by roasting the phosphate. It undergoes a

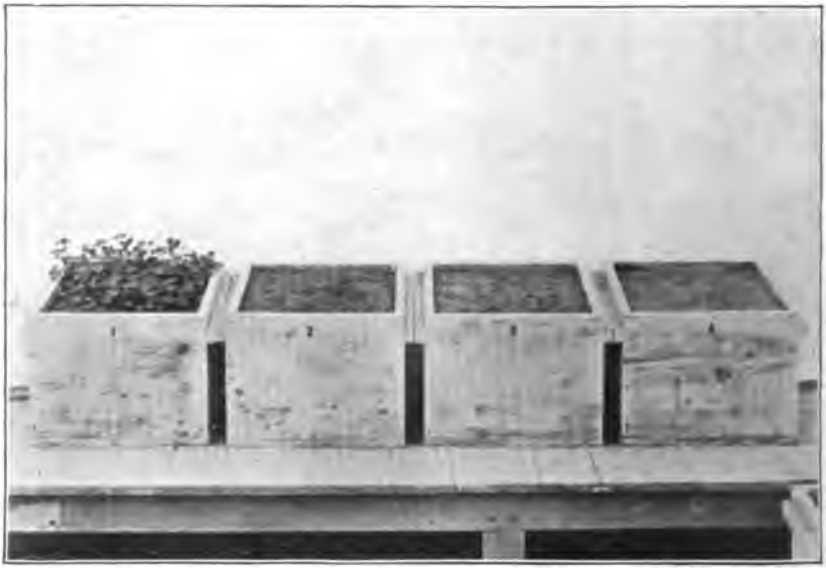
Peas.



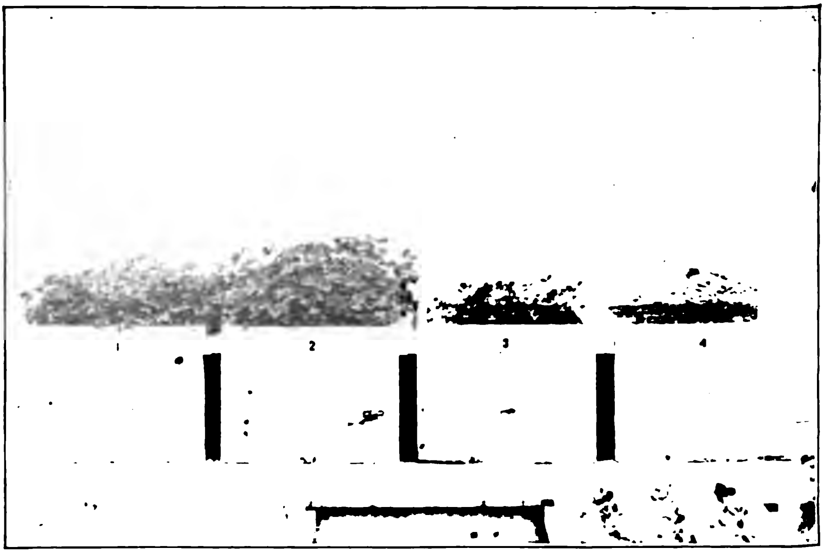
Box 1. Soluble Phosphoric Acid.
Box 2. Insoluble Phosphoric Acid—Florida Rock.
Box 3. Insoluble Phosphorate of Iron and Alumina.
Box 4. No Phosphate added.

Maine State College Experiment Station Report, 1895. Plate II.

Clover, immature.



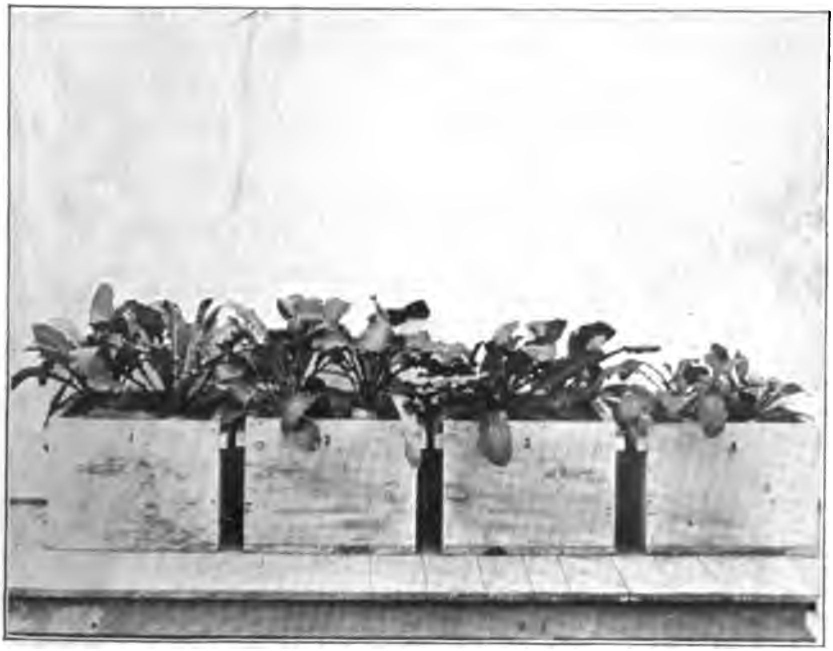
Clover, mature.



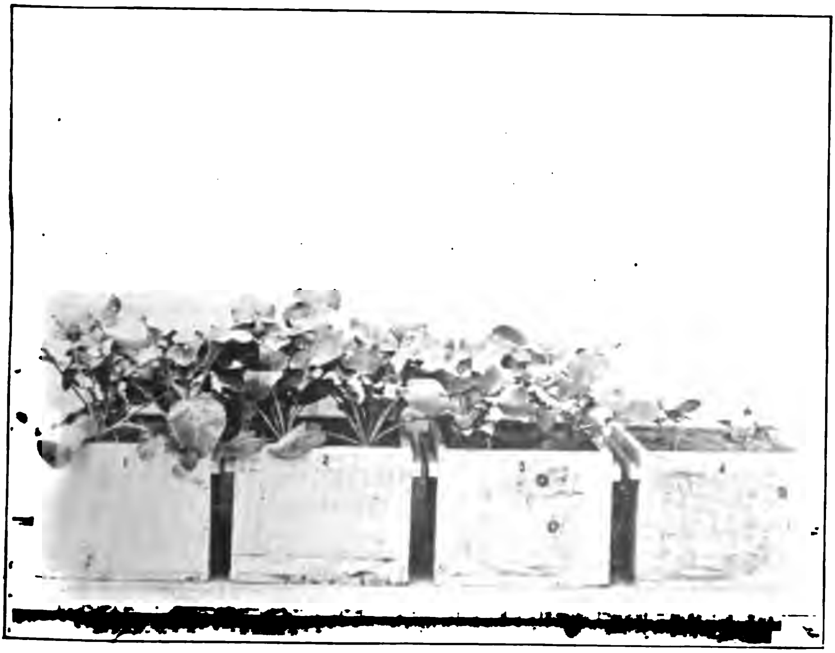
Box 1. **Soluble Phosphoric Acid.**
Box 2. **Insoluble Phosphoric Acid—Florida Rock.**
Box 3. **Insoluble Phosphorate of Iron and Alumina.**
Box 4. **No Phosphate added.**

Maine State College Experiment Station Report, 1895. Plate III.

Turnips.



Ruta-bagas.



Box 1. Soluble Phosphoric Acid.
Box 2. Insoluble Phosphoric Acid—Florida Rock.
Box 3. Insoluble Phosphorate of Iron and Alumina.
Box 4. No Phosphate added.

change on standing whereby the phosphate gradually becomes less soluble in the citrate solution.

Ninety-six boxes were used, twelve for each kind of plant. In the first box the acid rock was used; in the second, the crude rock; in the third, the phosphate of iron and alumina; in the fourth, no phosphate. The next four boxes were treated in the same manner, and so on to the end. Thus it will be seen that for each kind of plant there were three boxes which received the same treatment.

Twenty grams of the crude Florida rock, containing 6.576 grams total phosphoric acid, were used for a single box. Of the other phosphates such quantities were used as contained the same total amount, 6.576 grams, of phosphoric acid.

To each box were also added: Ten grams sodium nitrate; five grams potassium chloride; five grams magnesium sulphate. To the boxes containing the phosphate of iron and alumina and to those containing no phosphate were also added ten grams calcium sulphate. All these materials were carefully mixed with the screened sand before it was placed in the boxes.

The clover and barley were planted in seven rows of seven plants each, or forty-nine plants to each box. The peas were thinned to nine plants. Of the other plants, four were grown in each box. All the conditions were made as uniform as possible in order that whatever differences were observable might fairly be attributed to the differences in the phosphates used. The seed was carefully selected, that only being used which was well formed and of uniform size. Such leaves as ripened before the plants matured were removed, dried and added to the plants when harvested. No attempt was made at pollination. As very few insects were present during the growth of the plants, the fruiting, as might have been expected, was very irregular.

When the most advanced plants of each species had reached their highest development, all the plants of that species were harvested. The plants were carefully dried, weighed and ground. The moisture was determined in each sample and the water free weights calculated.

The experiments were continued through three periods. In the first period the barley matured its heads, and many of the pea-pods were well filled. The second period extended through the shortest days of the winter, when the lack of sun and the lower temperature were unfavorable to the best development of the corn and tomatoes. The third period was made shorter than the others, and none of the plants reached their full development.

At the close of the second period the clover was not harvested, but was allowed to grow on through the third period.

All but one of the photographs from which the accompanying cuts were made were taken at the close of the second period. The second cut of the clover is from a photograph made at the end of the third period, and represents the same plants as those shown in the preceding illustration.

TABLE I.

YIELD OF DRY MATTER IN GRAMS FOR EACH OF THE THREE PERIODS.

A represents the acid rock, B the crude rock, C the phosphate of iron and alumina, D no phosphate.

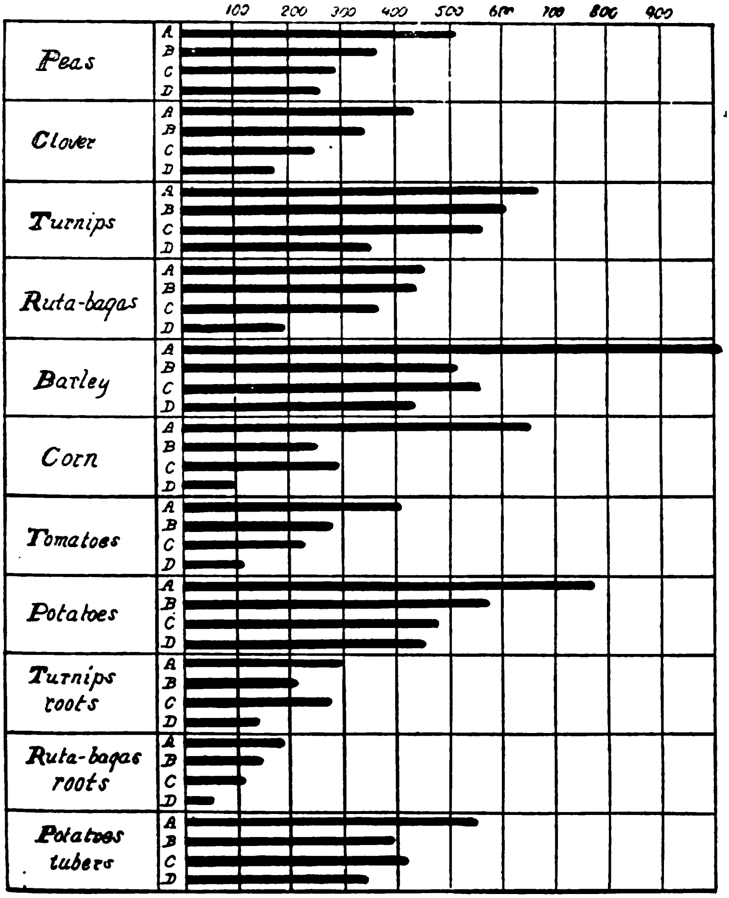
	First Period.				Second Period.				Third Period.			
	A	B	C	D	A	B	C	D	A	B	C	D
Peas	193.3	185.0	185.4	179.4	253.1	132.1	56.7	53.2	54.3	49.4	41.4	28.4
Clover	136.3	120.0	103.6	63.6	296.8	218.9	148.2	101.6				
Turnips	228.8	207.7	226.3	154.1	277.9	245.3	201.9	86.2	157.8	151.7	133.3	117.0
Rutabagas	154.9	167.6	176.8	132.0	240.0	215.6	132.5	31.0	61.0	52.5	55.8	30.1
Barley	335.8	269.5	259.1	197.0	500.0	131.5	164.2	127.2	179.6	113.1	136.1	112.6
Corn	491.1	228.9	261.7	61.6	55.5	7.4	6.3	6.3	106.9	17.6	25.8	24.9
Tomatoes	200.9	177.5	160.6	33.3	63.7	4.7	1.8	1.4	141.3	93.7	73.7	73.2
Potatoes	341.7	254.5	274.2	181.1	285.7	143.3	127.7	141.7	151.5	164.6	64.8	129.0
Turnips, roots	98.5	47.7	117.3	71.0	161.3	137.5	121.9	40.1	40.0	25.1	31.0	21.2
Rutabagas, roots	51.5	35.1	53.7	39.5	130.0	101.9	50.1	8.4	5.6	4.3	3.5	1.5
Potatoes, tubers	246.4	196.8	214.6	135.8	242.1	124.8	113.2	125.8	67.0	71.7	91.4	83.1

TABLE II.

TOTAL YIELD OF DRY MATTER FOR THE THREE PERIODS.

	A	B	C	D
Peas	500.7	366.5	283.5	261.0
Clover	433.1	338.9	251.8	165.2
Turnips, whole plant	664.5	604.7	561.5	357.3
Ruta bagas, whole plant	455.9	435.7	365.1	193.1
Barley	1015.4	514.1	559.4	436.8
Corn	653.5	253.9	293.8	92.8
Tomatoes	405.9	275.9	236.1	107.9
Potatoes, whole plant	778.9	562.4	466.7	451.8
Turnips, edible roots	299.8	210.3	270.2	132.3
Ruta bagas, edible roots	187.1	141.3	107.0	49.4
Potatoes, tubers	555.5	393.3	419.2	344.7

Table I shows the yield for each kind of plant grown, for each period. In Table II the weights for the three periods are condensed. The diagram which follows is designed to show graphically the same results as are given in Table II. Following the diagram may be seen the photographic illustrations showing the plants as they appeared at the time of harvesting.



A study of the tables and diagram shows:

1. All the plants receiving the phosphate of iron and alumina show a gain over those receiving no phosphate. This effect was most marked with the corn, the yield being three times as great as where no phosphate was used. The weight of the tomato plants was doubled. The turnips and ruta-bagas responded vigorously, the crop of roots being doubled. On the other hand, the peas and potatoes gained but little.

2. All the plants receiving the insoluble Florida rock show a gain over those to which no phosphate was given, the crops of clover ruta-bagas, corn, tomatoes and ruta-baga roots being more than doubled. The barley, potatoes and especially the potato tubers gained but little. All the plants showed a gain over those receiving the phosphate of iron and alumina except in the case of the barley, corn, turnip roots and potato tubers.

3. All the plants were benefited by the addition of the acid rock. The barley and corn show the most marked increase, the yield being double that from the crude rock. The ruta-bagas and the turnips derived nearly as much benefit from the crude rock as from the acid rock.

The effect of the acid rock was very marked, with all the plants grown, those receiving it, in nearly all cases, at once taking the lead and keeping it to the end. The plants were darker green in color, and the tubercules, which were developed on the roots of nearly all the leguminous plants, were larger and much more numerous. It was noticeable, however, that in some cases, especially with the clover, turnips and ruta-bagas, the good effects of the acid rock were more marked during the first few weeks of growth than at a later stage, when the roots had become more fully developed and had begun to forage for themselves. It would appear that the young plants feed but little upon the insoluble phosphates; but that the organic acids present in the sap of the roots exert a solvent action upon the insoluble phosphates in the soil, gradually converting them into available forms.

COMMENTS.

W. H. JORDAN.

It is often difficult, perhaps impossible in some instances, to so display experimental data that they shall convey to the reader the full significance of the results reached. This appears to be peculiarly the case with the forcing house experiments discussed on preceding pages by Mr. Merrill. The object of the investigation under discussion is a study of the ability, relatively and absolutely of certain plants to appropriate phosphoric acid to their uses when presented to them in various forms, or at least when applied to the soil in various forms.

These plants have been grown in a forcing house in a manner which has been described, where it has been possible to observe them through the various stages of development, and the writer by his observations is convinced of certain facts which are not easily made clear by a display of numerical data, either in a tabular or graphic form. Even the photographic illustrations fail to show more than one or two periods of growth.

The purpose, therefore, of supplementing Mr. Merrill's clear presentation of the facts reached is to emphasize his statements by a discussion based partly on numerical data and partly upon data which may not be expressed in numbers.

It is well to remark first of all, that this investigation may be regarded from two standpoints; (1) From the plant food side, when the prominent consideration is the availability of certain materials as plant food, or (2) from the plant side, when the prominent consideration is the absolute or relative ability of different species of plants to obtain food from certain sources. We will discuss our experimental data from both points of view.

(1) The acid-rock or soluble phosphoric acid proved to be the most available.

This is true whether we base our judgment upon the early growth of the young plants or upon the total growth made. There was no instance in which the young plants fed by the soluble phosphoric acid did not show a more immediate and generous growth than when fed by the water-insoluble, and if we consider only average results, the total growth was in all cases largest from the soluble phosphoric acid though not greatly larger with certain plants. If we consider the readiness with which any material is appropriated by the very young plant as the crucial test of its availability, then the phosphoric acid used in a soluble form has a relative value greater than is indicated by the growth of the plants during a somewhat extended period of time.

The influence of the soluble phosphoric acid was in the direction of early maturity because it induced prompt early growth, but it was not true in all instances that the final growth from this form of acid was very much or even any greater than from the water-insoluble forms. The plants grown on the soluble acid certainly were the earliest plants to mature, even though they finally grew no larger than some others. This fact is one of greater importance in the production of crops out of doors during a short season, than in the forcing house where the season may be indefinitely lengthened.

(2) The water-insoluble forms of phosphoric acid were used more or less freely by all of the eight species of plants grown. This was true both with the crude Florida rock and with the phosphates of iron and alumina, although the phosphoric acid from the ground Florida rock appeared to be the more freely used in a majority of cases. While as we shall see later, this availability of the water-insoluble phosphates varied greatly with different species of plants, it was sufficient in most instances to induce a material increase of growth. It is clear, however, when we consider that nearly all of the phosphoric acid of the phosphates of iron and alumina was soluble in ammonium citrate, that in these experiments, at least, the availability of the water-soluble phosphoric acid differed greatly in degree from the citrate-soluble. The present custom of classifying the water-soluble and citrate-soluble phosphoric acid of our fertilizers together as available does not appear to be rational in the light of these experiments.

(3) The solubility of a phosphate in an ammonium citrate solution at sixty-five degrees C did not in these experiments give a correct measure of the relative availability of the phosphoric acid after application to the soil.

Two mineral phosphates were used in these experiments, one being Florida rock, containing 2.46 per cent. of phosphoric acid soluble in an ammonium citrate solution at sixty-five degrees C, the other being the so-called Redonda phosphate, consisting chiefly of hydrated phosphates of iron and alumina, which, after dehydration, contained 42.77 per cent. of phosphoric acid soluble in ammonium citrate. In the one case only seven per cent. of the phosphoric acid was soluble in the citrate solution, while in the other case eighty-six per cent. of the phosphoric acid was soluble in that liquid. If the citrate soluble phosphates are actually readily available to plants both before and after entering the soil, then the dehydrated Redonda rock should have been greatly superior to the Florida rock as a source of plant food. This did not prove to be the case, the fact being that the Florida rock proved to be the more useful. Any impartial observer who watched these experiments must have been convinced that in a majority of cases the plants were feeding more readily upon the Florida rock than upon the other material and the figures reached substantiate this conclusion. Only with the barley and corn did the

Redonda phosphate show a superior value, which, though evident, was not marked.

There are two explanations which may be suggested for this fact:

(a) The action of the citrate solution is not even an approximate measure of the root action of plants, or (b) the dehydrated phosphates of iron and alumina revert to a hydrated and less available condition after entering the soil.

(4) The eight species of plants employed in these experiments showed greatly unlike ability to appropriate phosphoric acid from the water-insoluble phosphates. The differences in this respect were striking. From almost the very earliest period of growth, the two varieties of turnips appeared to feed nearly as freely upon the Florida rock as upon the dissolved Florida rock, whereas the barley, corn, potatoes and tomatoes derived but little if any benefit from the water-insoluble phosphates until during the more advanced stages of growth, and even then the benefit was not nearly so marked as with the cruciferous plants.

The leguminous plants, viz. peas and clover, appeared to occupy a position between the cruciferous and graminaceous plants, showing a very material increase of early development due to the water-insoluble phosphates.

The facts so far observed suggest that this difference in feeding power which these plants exhibited is more than a difference between single species and relates to groups of species.

(5) The ability to appropriate water-insoluble phosphoric acid appeared with some species of plants to greatly increase as the plants developed.

While the turnips and ruta-bagas fed freely upon the crude Florida rock even in the earlier stages of growth, it was observed that not until after some weeks did the clover, tomatoes and in one case the corn, begin to make any perceptible use of the water-nsoluble phosphates.

The photographs showing the clover in two stages of growth illustrate the above statement very clearly. This observed increase of feeding power as the plants matured, so that they fed upon the crude ground rock, especially the clover, suggests that the crude ground phosphates may be made a cheap and useful source of phosphoric acid in grass fields, and on the other hand the inability of several species, notably certain of the gramineae and solanaceae, to use the water-insoluble phosphates freely in the earlier periods of growth, emphasizes the wisdom of using chiefly water-soluble phosphoric acid upon hoed crops, especially where early maturty is essential.

The following table shows very clearly the relation of growth of the several species when fed with the different forms of phosphoric acid.

TABLE III.

RELATIVE PERCENTAGE YIELD WITH THE SEVERAL FORMS OF PHOSPHORIC ACID, THE YIELD WITH NO PHOSPHORIC ACID BEING TAKEN AS 100.

		Phosphoric acid soluble in water.	Phosphoric acid in ground Florida rock.	Phosphate of iron and alumina.	No phosphoric acid.
Peas	First period	108	108	108	100
	Second period	478	248	107	100
	Third period	191	174	146	100
Turnips	First period	148	135	147	100
	Second period	325	235	234	100
	Third period	135	130	114	100
Ruta bagas	First period	117	124	134	100
	Second period	774	695	427	100
	Third period	306	174	185	100
Barley	First period	170	187	131	100
	Second period	396	102	129	100
	Third period	159	100	121	100
Corn	First period	797	372	425	100
	Second period	881	117	100	100
	Third period	429	71	104	100
Tomatoes	First period	608	588	483	100
	Second period	4549	336	128	100
	Third period	186	128	101	100

THE PROFITABLE AMOUNT OF SEED PER ACRE FOR CORN.

W. H. JORDAN.

In 1894 an experiment was conducted for the purpose of testing the influence of the rate of seeding upon the growth of corn, the results being given in the Station Report for 1893, pp. 33-34. This experiment has been repeated in 1895 and the results are given below.

As in 1894 one acre of land was used. This area received a dressing of ten two-horse loads of stable manure and 750 pounds of commercial fertilizer, the latter being made up of 500 pounds acid phosphate, 100 pounds muriate of potash and 150 pounds nitrate of soda.The acre was divided into twelve plots, or four sets of plots with three plots in a set.

On one plot in each set the single kernels were planted six inches apart, on another nine inches, and on the third twelve inches. This gave four plots or one-third of an acre planted by each method. Great pains were taken to insure a stand of stalks in accordance with the plan, and the experiment appeared to be a success so far as the field work was concerned. The intention was to allow the corn to stand only until it began to glaze and then cut it and store it in the silo. Owing to a necessary delay, the corn stood until it was too ripe for the best results as a silage crop, and while this fact does not affect the actual or comparative yield of dry matter, it accounts for the loss per cent of water in the crop as harvested. Below may be seen the composition of the corn for 1895 and the rates of yield for both years.

COMPOSITION OF CORN FROM VARYING QUANTITIES OF SEED.

	COMPOSITION OF THE CORN AS HARVESTED IN 1895.					
	Water—per cent.	Ash—per cent.	Protein—per cent.	Fiber—per cent.	Nitrogen free-extract—per cent.	Fats—per cent.
Kernels 6 inches apart or 6 in 3 feet ..	62.58	1.88	2.77	7.60	23.73	1.44
Kernels 9 inches apart or 4 in 3 feet ..	61.53	1.40	3.37	6.25	25.79	1.66
Kernels 12 inches apart or 3 in 3 feet ..	64.55	1.68	3.10	6.67	22.57	1.43

YIELD PER ACRE OF CORN FROM VARYING QUANTITIES OF SEED.

Crop of 1894.			Crop of 1895.		
Total yield—pounds.	Per cent dry matter.	Yield dry matter—pounds.	Total yield—pounds.	Per cent dry matter.	Yield dry matter—pounds.
21,315	21.1	4,497	16,020	37.42	5,995
22,530	20.9	4,709	15,780	38.47	6,071
20,190	20.5	4,139	15,675	35.45	5,558

The results so far reached indicate that the amount of seed may vary greatly without materially affecting the yield of dry matter in the mature crop. The average yield per acre of dry matter for the two seasons with the several rates of seeding are as follows: Kernels six inches apart 5.246 pounds; at nine inches 5.390 pounds; at twelve inches 4.848 pounds.

There appears so far to be only a small difference between six inches and nine inches seeding, whereas the yield from the twelve inches was materially smaller both years.

It should be noted, that the corn from the nine inch and twelve inch seeding was eared more satisfactorily than that from the six inch.

SUNFLOWER HEADS AND BLACKEYE PEAS AS SILAGE CROPS.

J. M. BARTLETT.

In growing crops economically for this purpose two very important points must be considered.

1st. The adaptability of the crop to the process, its keeping qualities &c.

2nd. Its productiveness.

Corn is acknowledged by every one who has had much experience in the matter to be the great silage crop of this country. It is true that many other crops have been successfully kept in the silo but there is no other fodder which so uniformly produces good silage as corn.

If allowed to mature until the kernels become glazed it furnishes a valuable, succulent food for winter use, much relished by stock. It does not make, however, when fed with hay alone a properly balanced ration for milch cows. Both the grain and stalks are deficient in protein therefore it is necessary to feed with it some foods like cotton seed or linseed meal rich in protein to secure the best results.

Professor Robertson of Toronto, has suggested putting other fodders quite rich in protein with corn in the silo to make a more nearly balanced food. Horse beans and sunflower heads are the materials he uses and silage thus made has come to be called the Robertson Mixture. As a rule fodders rich in protein, like the legumes, do not keep well when put in the silo alone, but mixed with corn they are usually quite well preserved.

At the time this experiment was made, horse beans could not be obtained, consequently peas, which have about the same composition, were substituted.

It was necessary to plant them late in the season that they might not mature too early for the corn and sunflowers. The latter part of the season was unfavorable to their growth, mildew affecting them badly and consequently the yield was rather light. The sunflowers were grown on land put in the same condition as for corn, and the seed was planted one foot apart in drills three and one-half feet apart. The plants grew well and a good average yield was secured. The expense of raising the crop may be estimated to be the same as for corn.

The proportions of the different materials used for the silage was the same as for the Robertson Mixture namely: one-fourth acre sunflowers, and one-half acre of peas to one acre of corn. All were run through the cutter, packed in the silo by the ordinary method, and as is elsewhere noted, the silage kept perfectly and when opened in February was found to be in first class condition.

In the following tables will be found data giving information as to yield and composition of the crops.

TABLE IV.

YIELD PER ACRE.

	Fresh—pounds.	Air-dry—lbs.	Water-free—pounds.
Sunflower heads	12,720	2,200	2,040
Peas, whole plant	13,380	2,013	1,861

TABLE V.

COMPOSITION OF SUNFLOWER HEADS AND PEAS.

	AIR DRY.						WATER FREE.				
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.
	%	%	%	%	%	%	%	%	%	%	%
Sunflower heads	7.27	6.73	12.63	24.4	34.56	14.41	7.26	13.62	26.30	37.27	15.55
Blackeye peas	7.57	7.45	17.19	30.00	35.18	2.61	8.06	18.60	32.47	38.04	2.83
	FRESH PLANT.										
Sunflower heads	84	1.16	2.18	4.21	5.96	2.49					
Peas, whole plant	86.1	1.12	2.59	4.51	5.29	.39					

TABLE VI.

YIELD PER ACRE OF NUTRIENTS COMPARED WITH MAINE FIELD CORN AND RED CLOVER.

	Dry substance—pounds.	Protein—pounds.	Carbohydrates—pounds.	Fat—pounds.
Maine field corn	4,224	385	3,469	156
Red clover	3,400	520	3,150	183
Sunflower heads	2,040	278	1,296	317
Peas, whole plant	1,861	249	1,312	53

TABLE VII.

NUTRIENTS PER TON OF TWO THOUSAND POUNDS WATER FREE SUBSTANCE COMPARED WITH OTHER FODDERS.

	Peas—pounds.	Sunflower heads—pounds.	Red clover—pounds.	Timothy—pounds.	Mature Flint corn—pounds.	Immature Southern corn—lbs.
Protein	372.0	272.4	306	160	184	166
Carbohydrates....................	1,410.2	1,271.4	1,472	1,670	1,622	1,668
Fat..............................	58.6	311.0	78	62	74	52
	1,838.8	1,854.8	1,856	1,892	1,880	1,886

SUMMARY.

So far as is indicated by this experiment it would seem that sunflowers are not nearly as profitable a crop to raise as corn. With the same cultivation corn produces a third more protein and nearly twice as much carbohydrate material as sunflower heads.

When compared with our common red clover it will be seen that an average crop of the latter plant produces nearly twice as much protein and more carboyhydrate matter per acre. From this very limited experience we are not favorably impressed with the sunflower as a profitable silage crop. The peas are not considered, as a fair average crop was not secured.

FEEDING EXPERIMENTS WITH MILCH COWS.

J. M. BARTLETT.

For the following experiments six cows known by the numbers 1, 2, 3, 4, 5 and 6 were used. All were grade Jerseys except number 4 which was a thoroughbred.

Nos. 4, 5, 6, were owned by the station and used for experimental work the previous year. Nos. 1, 2, 3, were purchased a short time before beginning the experiments. Although they were all fairly good cows their condition was not such as to make them most desirable for experimental purposes. In comparing one ration with another it is necessary to avoid heavy feeding else the differences that one kind of food might show in comparison with another might be obliterated by the excess of nutrients fed in a large ration. It is therefore essential that a grain ration near the minimum rather than the maximum limit should be employed to secure results of any value.

Cow No. 4 was rather old and had also been receiving more grain than could be used in experimental feeding, consequently she shrank rapidly in flesh and milk yield when put on the smaller ration.

Nos. 1, 2, 3, had been fed quite liberally on cotton seed meal by their previous owner and a reduction in their grain, together with the effect of transporting them 100 miles in very cold weather,caused a very material shrinkage in the milk flow. No. 1 proved to be worthless for our work as she leaked her milk quite badly, and was changed for another animal during the latter part of the first experiment.

The cows were so nearly of a size that they were all fed alike. They were weighed at the beginning and end of each period. The milk of each cow was carefully weighed at each milking and samples taken during the last five days of the periods were analyzed and the results taken as an average for the period in which they were obtained. All food given the cows was weighed as was also the water they drank.

The temperature of the stable was taken morning, noon and night.

EXPERIMENT I.

WHEAT MEAL COMPARED WITH CORN MEAL.

It occasionally happens as was the case in the fall of 1894 that the crops in the corn raising belt are cut off through drought or other causes while those in the wheat belt are bountiful. At such times the country is therefore deficient in its corn supply and the price of that grain advances. On the other hand wheat is plentiful and sells at a low figure. At the time this experiment was made corn was selling at ten cents more per hundred pounds than wheat meal and dealers in this section said they were selling more wheat for feed than corn, and farmers naturally were asking which was the more economical grain to feed at those prices. Chemical analysis shows wheat to be slightly richer in protein and to contain on the average less moisture than corn meal. We should therefore consider it worth more pound for pound to feed and the following data would seem to sustain that position:

THE TWO RATIONS FED DAILY.

RATION I.	RATION II.
Timothy hay, 18 pounds.	Timothy hay, 18 pounds.
Wheat meal, 5 pounds.	Corn meal, 5 pounds.
Cotton seed meal, 2 pounds.	Cotton seed meal, 2 pounds.

TABLE VIII.

COMPOSITION OF FOODS USED.

	Water—%.	Ash—%.	Protein. —%.	Fiber—%.	Nitrogen free-extract—%.	Fat—%.
Timothy hay	13.18	4.37	5.87	29.03	45.08	2.47
Wheat meal	9.29	2.10	12.81	2.62	71.06	2.12
Corn meal	14.98	1.42	9.17	1.90	68.76	3.77
Cotton seed meal	8.17	7.17	42.31	5.62	23.65	13.08

TABLE IX.

FOOD CONSUMED BY EACH COW FOR EACH PERIOD OF TWENTY-ONE DAYS.

PERIOD I.	PERIOD II.	PERIOD III.
Timothy hay 348 lbs	Timothy hay 348 lbs	Timothy hay 348 lbs.
Wheat meal 105 lbs	Corn meal 105 lbs	Wheat meal 105 lbs.
Cotton seed meal 42 lbs	Cotton seed meal 42 lbs	Cotton seed meal 42 lbs.

TABLE X.

*DIGESTIBLE NUTRIENTS CONSUMED BY EACH COW.

PERIOD I.		PERIOD II.		PERIOD III.	
	Pounds.		Pounds.		Pounds.
Protein	37.51	Protein	32.29	Protein	37.51
Carbohydrates	237.57	Carbohydrates	237.35	Carbohydrates	237.57
Fat	12.55	Fat	14.19	Fats	12.55
Total	287.63	Total	283.83	Total	287.63
Nutritive ratio 1 to 7.09.		Nutritive ratio 1 to 8.7.		Nutritive ratio 1 to 7.09.	

* American coefficients were used—those given for wheat middlings were used for the wheat meal.

TABLE XI.

WATER DRANK DAILY (POUNDS).

NUMBER OF COW.	1	2	3	4	6
First period	57	60	68	58	57
Second period	64	65	77	59	57
Third period	-	70	81	60	60

TABLE XII.

COMPOSITION OF MILK FOR LAST FIVE DAYS OF EACH PERIOD.

	Cow 1.		Cow 2.		Cow 3.		Cow 4.		Cow 6.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%
January 11	13.39	4.35	13.82	4.60	12.26	3.60	12.90	4.60	14.98	5.20
January 12	13.48	4.45	13.84	4.55	12.42	3.75	12.68	3.95	14.55	4.75
January 13	13.34	4.30	13.69	4.40	12.20	3.45	12.62	4.05	14.48	5.00
January 14	13.42	4.20	13.80	4.60	12.88	4.10	13.04	4.70	15.09	5.10
January 15	13.73	4.40	13.81	4.40	12.87	3.90	13.06	4.60	15.18	5.35
Average	13.47	4.34	13.79	4.51	12.52	3.76	12.85	4.38	14.85	5.08
February 1	13.52	4.15	14.33	4.75	12.88	3.80	13.78	4.85	15.19	5.15
February 2	13.36	4.30	13.94	4.65	12.74	4.10	13.28	4.40	14.96	5.30
February 3	13.71	4.70	14.03	4.80	12.75	3.07	13.09	4.40	15.25	5.45
February 4	13.62	4.60	14.39	4.95	12.71	3.80	13.32	4.30	15.40	5.40
February 5	13.23	4.20	13.89	4.15	13.01	4.10	13.86	4.90	15.10	5.15
Average	13.49	4.39	14.11	4.66	12.82	3.77	13.47	4.57	15.18	4.29
February 22	......	......	14.36	4.85	13.35	4.10	13.94	5.00	15.21	5.30
February 23	......	......	14.63	4.20	13.32	4.40	14.34	5.15	15.81	5.55
February 24	......	.....	14.32	5.00	13.46	4.35	14.50	5.45	15.68	5.55
February 25	.....	......	14.65	5.20	13.61	4.50	14.48	5.65	16.05	5.75
February 26	.....	......	14.54	5.20	12.77	4.00	14.36	5.40	15.02	5.30
Average	. ..	......	14.50	4.89	13.30	4.27	14.32	5.33	15.55	5.49

TABLE XIII.

MILK YIELD PER WEEK IN POUNDS, AND AVERAGE TEMPERATURE OF STABLE.

DECEMBER 26 TO JANUARY 15.	Temperature —Fahrenheit.	NUMBER OF COWS.				
		1.	2.	3.	4.	6.
First week	....	114	147.8	156.5	143.6	125.6
Second week	41	104.3	147	155	126.6	115.1
Third week	47	112.8	142.5	159	119.3	119.9
JANUARY 16 TO FEBRUARY 5.						
First week	45	105.3	141.3	153.9	114.8	121.1
Second week	44	106.1	139.1	152.7	114.3	120
Third week	41	100.8	140.6	148.9	111.7	118.5
FEBRUARY 6 TO FEBRUARY 26.						
First week	38	....	132.7	140.6	101.5	113.9
Second week	49	....	127.5	141.3	96.7	114.6
Third week	44	....	126.0	134.6	87.3	111.4

TABLE XIV.

WEIGHT OF COWS. WEIGHT GAINED. WEIGHT LOST. MILK, SOLIDS AND FAT PRODUCED BY EACH COW (POUNDS.)

	Cow.	Weight.	Weight gained.	Weight lost.	Milk.	Solids.	Fat.
	1	830	5	......	336	45.26	14.58
PERIOD I.	2	930	15	......	437.37	60.32	19.73
(Wheat meal.)	3	880	......	5	469.37	58.77	17.65
21 days.	4	830	....	15	389.50	50.17	17.05
	6	859	8	.. .	360.75	53.58	18.32
Total	......	......	28	20	1,992.99	268.10	87.33
Total omitting I	.....	.. . .	......	......	1,656.99	222.84	72.75
Daily yield	......	......	......	......	19.73	2.65	.87
	1	835	.....	18	322.25	43.54	14.15
PERIOD II.	2	945	......	30	421.00	59.40	19.62
(Corn meal.)	3	875	... .	20	455.37	58.11	17.09
21 days.	4	815	......	6	340.87	45.88	15.58
	6	867	......	2	359.62	54.57	19.02
Total	......	......	......	76	1,899.11	261.50	85.46
Total omitting I	.....	......	......	......	1,576.86	217.96	71.31
Daily yield................	.....	.....	.....	....	18.78	2.60	.85
PERIOD III.	2	915	10	......	386.25	55.99	18.88
(Wheat meal.)	3	855	5	.....	416.50	55.39	17.78
21 days.	4	804	......	19	287.50	41.17	15.32
	6	865	10	.....	339.75	52.84	18.66
Total	......	......	25	19	1,430.00	205.39	70.44
Daily....................	......	......	......	......	17.03	2.45	.84

Conclusions drawn from the foregoing data.

1st. Wheat meal pound for pound furnishes more food than corn meal, noticeably more digestible protein. Table X.

2nd. When wheat can be bought at about the same price as corn it is a more economical grain to buy.

3rd. It is more valuable than corn to feed with hay or such grains as barley and oats because richer in protein.

4th. When fed to milch cows in the proportions given in this experiment it produced as much milk and greater gain in flesh, as shown in Table XIV. It is very noticeable that the rations fed in Period I and III were more efficient than that fed in Period II. While there was a very gradual and uniform shrinkage in milk solids through all the periods, due to the advance in time of lactation, the fact that the cows all lost weight in Period II and gained again, with the exception of No. 4, in Period III, furnishes good grounds for the above statement.

EXPERIMENT II.

ENSILAGE COMPOSED OF MATURE FLINT CORN, SUNFLOWER HEADS AND PEAS AS FOOD FOR MILCH COWS.

When this experiment was planned it was the intention to use the so called Robertson Mixture of corn, sunflower heads and horse beans, but as no horse beans could be procured in time for planting, Blackeyed peas were substituted. The peas were sown quite late that they might not mature too early for the corn and sunflowers. The materials were all harvested and put in the silo at the proper stage of maturity, the latter part of September. The last of February the silo was opened and the silage found to be in most excellent condition, being perfectly preserved and when fed was much relished by the stock.

The object of making the mixture was to secure a more nearly balanced ration than is furnished by corn alone. The peas were added to increase the protein and the sunflower heads the protein and fat, the seeds being very rich in oil.

Every farmer is well aware of the great efficiency of a pasture grass ration,and if we can therefore produce a succulent food for winter use that will approach approximately the composition and digestibiltiy of pasture grass,we shall be able in part to substitute it for the grain now fed and thereby save something of the enormous outlay expended by farmers for that purpose.

It is perhaps true that just at the present time protein can be more cheaply purchased in cotton seed meal than it can be produced on an Eastern farm, but the time is not far distant when we may expect to see that most excellent food very materially advance in price. The Southern and Western farmers are beginning already to appreciate its value and are feeding large quantities to stock, and we have every reason to believe that this practice will increase with the constantly growing dairy interests of those regions.

The details of the experiment are given in the following tables.

It will be noticed that the grain ration fed the first Period was light but was thought to be sufficient with the amount of ensilage used and just the reason why in the first period some of the cows should lose in weight and maintain their milk flow and then gain in weight and lose in milk flow during the second period, is not apparent unless the changes were due to variation in the stomach and intestinal contents at the times of weighing rather than any actual gain or loss in flesh.

TABLE XV.

	Fine hay—pounds.	Corn meal—pounds.	Cotton seed meal—pounds.	Bran—pounds.	Ensilage—pounds.
Ration I	10	3	1 1-2	1 1-2	30
Ration II	10 4-7				50
Ration III	10	1-2	3-4	3-4	50

TABLE XVI.

FOOD CONSUMED BY THE FIVE COWS IN EACH PERIOD.

Period I.		Period II.		Period III.		Period IV.		Period V.	
	Pounds.		Pounds.		Pounds.		Pounds.		Pounds.
Hay	700	Hay	740	Hay	700	Hay	700	Hay	700
Silage	2,100	Silage	3,500	Silage	2,100	Silage	3,500	Silage	2,100
Corn meal,	210			Corn meal,	210	Corn meal	105	Corn meal	210
C. S. meal.	105			C. S. meal.	105	C. S. meal,	52½	C. S. meal,	105
Bran	105			Bran	105	Bran	52½	Bran	105

TABLE XVII.

COMPOSITION OF FOODS USED.

	Water—per cent.	Ash—per cent.	Protein—per cent.	Fiber—per cent.	Nitrogen free-extract—per cent.	Fats—per cent.
Hay—bluegrass	5.10	4.92	6.81	30.00	49.78	3.39
Corn meal	14.98	1.42	9.17	1.90	68.76	3.77
Cotton seed meal	8.17	7.17	42.31	5.62	23.68	13.08
Bran	11.91	5.78	15.42	8.99	53.87	4.03
Silage	76.31	1.81	2.89	5.56	12.17	1.26

TABLE XVIII.

TOTAL AND DIGESTIBLE NUTRIENTS CONSUMED BY EACH COW FOR EACH PERIOD.

	Period I. Pounds.	Period II. Pounds.	Period III. Pounds.	Period IV. Pounds.	Period V. Pounds.
(Total.)					
Protein	37.65	30.28	37.65	37.72	36.32
Carbohydrates	237.22	242.34	237.22	261.32	229.31
Fat	14.20	13.80	14.20	16.13	13.91
Total organic matter	289.07	286.42	289.07	315.17	279.54
Eaten daily	20.6	20.4	20.6	22.5	19.9
(Digestible.)					
Protein	26.17	18.80	26.17	24.92	24.39
Carbohydrates	165.40	166.87	165.40	183.46	157.95
Fat	11.80	10.79	11.80	12.05	11.39
Total organic matter	203.37	196.46	203.37	220.43	196.73
Eaten daily	14.5	14.0	14.5	15.7	13.8
Nutritive ratio	1 to 7.33	1 to 10.02	1 to 7.33	1 to 8.45	1 to 7.53

TABLE XIX.

AVERAGE AMOUNT OF WATER DRANK DAILY BY EACH COW.

	1. Pounds.	2. Pounds.	3. Pounds.	5. Pounds.	6. Pounds.
Period I	35	38	48	29	37
Period II	26	38	46	37	35
Period III	36	47	61	48	44
Period IV	43	49	62	47	47
Period V	44	49	61	47	4

TABLE XX.

AVERAGE COMPOSITION OF MILK FOR LAST FIVE DAYS OF EACH PERIOD.

Cows.	1.		2.		3.		5.		6.	
	Solids—%.	Fat—%.	Solids—%.	Fat—%.	Solids—%.	Fat—%.	Solids—%.	Fat—%.	Solids—%.	Fat—%.
Period I… ……………	13.78	4.33	14.18	5.04	12.87	4.13	12.57	4.07	14.80	5.27
Period II………………	13.50	4.28	13.77	4.78	12.42	3.98	12.88	3.67	15.04	5.42
Period III ….. ………	13.36	4.19	14.26	4.97	12.99	3.97	12.29	4.07	14.39	4.64
Period IV………… ….	13.81	4.31	14.36	4.81	13.19	3.94	12.74	4.07	14.33	5.05
Period V…… …. ….	13.81	4.44	14.77	5.04	13.87	4.39	12.88	4.25	13.95	4.74

TABLE XXI.

TEMPERATURE OF STABLE AND YIELD OF MILK FOR EACH COW PER WEEK.

	Temperature of stable—Fahrenheit.	MILK PRODUCED BY COWS.				
		1. Lbs.	2. Lbs.	3. Lbs.	5. Lbs.	6. Lbs.
March 16 to March 29.						
First week……… ………………	45°	97.8	102.9	137.7	159.4	123.1
Second week ……. ……………	50°	102.5	107.4	136.1	151.6	124.4
March 30 to April 12.						
First week….. ……. …………	50°	91.3	93.4	121.3	135.6	121.6
Second week……………………	52°	88.3	90.8	113.0	131.5	108.3
April 13 to April 27.						
First week. ………… … ………	54°	86.8	94.3	119.0	143.8	125.1
Second week.. …………………	58°	101.0	106.0	123.6	145.9	139.9
May 4 to May 17.						
First week………………………	70°	100.9	97.0	110.9	140.8	133.6
Second week . ……. ……. …..	63°	102 3	104.6	113.3	141.3	137.3
May 18 to May 31.						
First week…………… . ………	58°	101.9	98.9	102.9	138.1	130.9
Second week ……………… ….	65°	105.3	101.5	94.8	135.6	145.6

TABLE XXII.

WEIGHT OF COWS—GAIN AND LOSS IN WEIGHT—POUNDS OF MILK, SOLIDS AND FAT PRODUCED BY EACH COW FOR EACH PERIOD.

	Number cow.	Weight of cow—pounds.	Gain in weight—pounds.	Loss in weight—pounds.	Milk—pounds.	Solids—pounds.	Fat—pounds.
Period I. 14 days.	1	922	4		200.3	27.6	8.67
	2	923		23	210.1	29.8	10.00
	3	857		14	273.8	35.3	11.34
	5	708	7		311.0	39.1	12.66
	6	875		7	247.5	36.6	13.65
Total			11	44	1,242.7	168.4	56.32
Daily yield					17.8	2.41	.81
Period II. 14 days.	1	926		3	179.5	24.9	7.65
	2	896	22		188.4	25.2	8.76
	3	843	9		234.8	29.1	9.32
	5	715	2		267.1	33.1	9.80
	6	868		15	229.9	32.7	12.45
Total			33	18	1,094.2	145.0	47.98
Daily yield					15.6	2.07	.685
Period III. 14 days.	1	923	15		187.8	25.1	7.87
	2	918	7		200.3	28.00	9.55
	3	852		12	242.6	31.50	9.68
	5	717	3		289.6	36.9	11.80
	6	853		8	265.0	38.1	12.88
Total			25	20	1,185.3	159.6	51.64
Daily yield					17.0	2.28	.74
Period IV. 14 days.	1	938	10		203.2	28.1	8.77
	2	925	3		201.6	29.0	9.70
	3	840	14		224.1	29.6	8.82
	5	720	2		282.0	35.9	11.48
	6	845	12		270.9	38.8	13.70
Total			41		1,181.8	161.4	52.47
Daily yield					16.9	2.30	.75
Period V. 14 days.	1	952	12		207.1	28.6	9.30
	2	929	13		200.4	29.6	10.10
	3	860	5		197.6	27.4	8.68
	5	723		16	273.8	35.3	11.60
	6	862	23		276.6	38.6	13.10
Total			53	16	1,155.5	159.5	52.68
Daily yield					16.5	228.0	.75

TABLE XXIII.

TOTAL AND DIGESTIBLE NUTRIENTS EATEN FOR EVERY POUND OF MILK, SOLIDS, AND FAT PRODUCED.

	Period I—lbs.	Period II—lbs.	Period III—lbs.	Period IV—lbs.	Period V—lbs.
(Total Nutrients.)					
Milk	1.15	1.31	1.22	1.13	1.21
Solids	8.53	9.87	9.05	9.76	9.44
Fat	25.5	29.8	27.98	30.04	28.6
(Digestible Nutrients.)					
Milk	.82	.90	.86	.96	.84
Solids	6.04	6.77	6.37	6.83	6.07
Fat	18.10	20.50	19.70	21.02	18.40

From the data presented in the preceding tables we are warranted in making the following summary.

1st. That the materials composing the silage used can be perfectly preserved and successfully kept in the silo as late as June of the following year.

2nd. That the pea, sunflower and corn mixture produces a silage somewhat richer in protein than corn alone and is very greedily eaten by stock.

3rd. That to attempt to substitute this mixture entirely for the grain ration was not a success as shown by Table XXII, the cows shrinkng quite materially in their flow of milk without an increase in its richness. The shrinkage was undoubtedly due to a lack of digestible protein as will be seen by consulting Table XVIII; the total and digestible organic matter consumed was practically the same but the protein was considerably less than in Period I. On returning to the grain and silage ration in Period III the flow of milk was increased to nearly the original yield.

4th. In Period IV silage was substituted for one-half the grain ration, twenty pounds silage for three pounds grain, with good results. All the cows increased in weight and shrank no more in milk than would be expected from the advance in time of lactation, the solids and fat increasing slightly.

THE RELATION OF FOOD TO THE GROWTH AND COMPOSITION OF THE BODIES OF STEERS.*

W. H. JORDAN.

GENERAL CONSIDERATIONS.

The problems pertaining to animal nutrition are among the most difficult of solution of any that confront the investigator. This is due largely to the fact that many of the phenomena, chemical and physical, which occur in the animal organism and that are involved in the processes of growth, are hidden from the ordinary means of observation. An animal eats, digests and assimilates food and as a result uses energy and forms tissues of various kinds. We know that in some way the food supplies the materials for growth,but such questions as the nutritive office of the single compounds of the food and the effect upon the animal of varying these compounds in their relative quantities, are so far partially answered. Such information as we do possess along these lines has been obtained partly by circumstantial rather than by direct evidence, and many conclusions have been inferential in their nature and are not the outcome of direct testimony. Only investigations long continued and of the most searching kind are competent to reveal the nature and extent of the chemical and physical changes in the animal body. The ordinary practical feeding experiments, while they may furnish guides for practice, explain none of these troublesome problems. If one animal increases in weight more rapidly on one food mixture than another animal does on a widely different ration we simply know the fact. The explanation of the fact we may infer with a fair chance of a wrong inference in some cases. First of all we are not sure that the actual growth is proportional to the increase in weight, although where the experiment covers a long period of time it is reasonable to assume that such is the case. Again, granting that great differences in actual growth of tissue actualy exist, we cannot now fully explain, perhaps never can, in what way the food is responsible for these differences. The need of fuller knowledge concerning the fundamental facts of digestion and metabolism is a pressing one and the investigator who is using the respiration apparatus and other scientific facilities in a search for this knowledge has before him great possibilities for valuable service. But this lack of knowledge does not constitute a reason why observations of a practical character should not be continued. Feeding experiments may convince us of certain facts which science shall sometime explain. We should demand, however, that the conclusions derived from these experiments shall be fortified by all the accurate data which it is possible to secure, and so in studying the relation of food to growth, it is essential to know not only the amount and kind of nutrients supplied to the animals but also the extent and character of the growth produced.

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* Analyses performed by J. M. Bartlett and L. H. Merrill,—the animals in care of A. M. Shaw.

THE PROBLEM STUDIED.

There is much discussion at the present time, of the relative influence and economy of various food combinations. "Standard rations," "narrow ratio" and "wide ratio" are familiar phrases, all of which have to do with a wide spread conviction that the manner in which foods of different classes are combined has much to do with the character of the product and the profit of feeding animals.

It is generally taught that a given amount of digestible food should have not less than a certain proportion of protein in order that it may cause a maximum production, and scientific data, practical feeding experiments and even common experience appear to warrant such teaching. It is claimed, still further, that not only the amount but the kind of product is to an extent under the control of the food, and the experiments of Sanborn, Henry, Roberts and Georgeson with swine, lambs and steers appear to substantiate this claim, certainly so far as it relates to swine.

In all these experiments the evidence of the effect of the food in modifying the composition of the carcass is simply the apparent relative amount of the fat and lean tissues, save in certain instances where a chemical analysis was made of a portion of the carcasses, too small to furnish reliable data. With the swine in some cases the differences in the carcasses in their proportions of lean and fat were too unmistakable to allow an erroneous judgment, but with the sheep and steers no past experiments seem to have been so conducted as to prove that the rations differed in effect other than to cause more growth or less growth. Moreover, the experiments with ruminants for the purpose of studying the effect of food upon the kind of growth were not begun with the young animals and continued until they reached a somewhat mature growth, but covered only such periods of time as would be required to fatten the animals for the market.

The experiment which is detailed in the following pages had for its object a study of the effect of widely different rations upon the rate of growth and composition of the bodies of steers, and it is believed in that two particulars it is a distinct improvement upon similar experiments previously conducted: (1) The feeding was begun with the animals as calves and continued from seventeen to twenty-seven months or until the steers had attained a size from 870 to 1300 pounds. (2) The bodies of the animals, excepting the skins, were entirely submitted to chemical analysis.

PLAN OF THE EXPERIMENT.

Character of the steers. Four steer calves were purchased in the summer of 1893 of R. & C. D. Waugh, Starks, Me., and they reached the station on June 7th. Their breeding is described in the following extract from a letter from the Messrs. Waugh. "The men that raised the calves have kept thoroughbred Durham bulls for over forty years, and they are high grades."

The calves were therefore not full blooded animals but were high Shorthorn grades, and were quite uniform in quality. One pair was two or more months older than the other two, and in dividing the animals into two lots one older and one younger animal were assigned to each lot. At the time when the experimental feeding began the age of the calves ranged from five to seven months.

The rations. The steers were fed alike until the last week of August, 1893, at which time the feeding of the experimental rations begun. On September 1st, the animals were weighed for the first time and from that date a record of the daily rations and weekly changes in live weight was kept until the end of the experiment.

The grain rations consisted of mixed grains with both lots. At first Steers 1 and 2 were fed a mixture consisting of one part linseed meal one part corn meal and one part wheat bran, by weight.This mixture was continued until January 22, 1894, when it was changed to one consisting of two parts linseed meal, one part corn meal and one part wheat bran, which was continued throughout the remainder of the experiment. Steers 3 and 4 were fed during the entire experiment on a grain mixture consisting of two parts corn meal and one part wheat bran, by weight.

The coarse food consisted entirely of hay, except in the winter 1893-4 when corn fodder and corn silage were also fed. At no time was the daily ration what would be considered heavy feeding. The object of the experiment was to discover the specific effect of quite different rations rather than to produce the largest possible animals within a given time, and to this end the rations were restricted to a moderate quantity, on the ground that less vicissitudes would attend the experiment and that any thing approaching an excess of food would tend to obscure the influence of a more or less favorable combination of nutrients.

At the beginning, the daily ration was five pounds of hay or its equivalent and one pound of mixed grain, and the largest ration fed to any steer during the entire experiment was thirteen pounds of hay and eight pounds of grain. Considering the small amount of food eaten, the growth of the animals was very satisfactory.

As can be readily seen, neither of the rations fed can be considered as unusual. Neither one is unlike what might be found in the practice of many cattle feeders. Neither one includes extraordinary materials or proportions of nutrients. The one was compounded to a nutritive ratio not unlike the German standard rations for growing animals, and the other was made up so as to represent what is called a "wide ration." Both rations were consistent with health and a normal development of the animals and doubtless both would be included within the limits of good practice, if these limits are to be bounded by the extremes of opinion among practical feeders.

The essential difference between the two rations lies in the marked difference in the proportions of protein which they contained, and the discussion of results centers around this fact. Certainly it cannot be claimed in either case that there was a deficiency of bone making material or that any other especially abnormal condition prevailed.

The manner of the experiment. Throughout the entire time the steers were stall fed, mostly, as previously stated, upon dry food. During all seasons they were allowed exercise in a large yard, excepting during rain storms or the severest winter days. The food was weighed out daily and the animals were weighed on three consecutive days of each week, the averages of these three weighings being taken as the actual weights. The grains were not weighed out separately on each day, but were mixed in large quantities, the total daily ration being obtained by a single weighing. Each new mixture of grains was sampled and the samples were submitted to chemical analysis. Analyses were also made of the corn fodder and silage eaten, but not of the hay.

It is a matter for congratulation that the experiment progressed in an unusually satisfactory manner. The animals were continuously in good health and no accidents or disturbances of any kind occurred to mar the success of the work, which, considering that the experiment covered more than two years time, must be regarded as a piece of good fortune.

In January and February 1895 two animals, one from each lot, Nos. 1 and 4, were killed and analyzed. These steers had been fed experimentally about seventeen months and weighed 958 and 870 pounds respectively. The other two animals, Nos. 2 and 3 were fed for more than ten months longer or until during December 1895 and weighed when slaughtered 1300 and 1280 pounds. These latter animals had been fed therefore over twenty-seven months.

As the animals were slaughtered, the blood, the various organs and the carcasses were weighed and all these parts were immediately prepared for analysis, the main object of the experiment being to determine the actual quantities of ash, protein and fats that had been produced in the bodies of the several steers.

The food. The grains were purchased in the Bangor market. The hay fed was mostly timothy and was nearly all raised on the College Farm. The corn fodder and silage were also from corn produced by the experiment station in 1893.

The composition and digestibility of the foods. As before stated the grains were mixed in large lots and samples were taken for analysis. No analyses were made of the particular hay eaten, but it is assumed to have a composition similar to the average composition of the hay produced on the College Farm during five previous seasons.[*]

The corn fodder and silage are assumed to have the same composition as the entire lots of southern corn and field corn for the year 1893.[**]

Table XXIV shows the composition of various foods.

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[*] See Report Maine Experiment Station, 1889, p. 89.

[**] See Report Maine Experiment Station, 1893, p. 27.

TABLE XXIV.

COMPOSITION OF THE FOODS.

	Composition as Fed.					
	Water.	Ash.	Protein.	Fiber.	Nitrogen free-extract.	Fats.
Hay (assumed)	% 13.0	% 4.12	% 6.76	% 28.55	% 44.66	% 2.91
Southern corn fodder (or silage)	84.0	1.2	1.8	4.4	8.2	.4
Field corn fodder (or silage)	80.5	1.2	2.4	4.1	11.3	.5
Mixed grains, fed steers 1 and 2:						
Lot mixed August 25, 1893	11.34	3.48	19.87	6.07	53.51	5.73
December 20, 1893	11.25	4.28	21.43	6.71	51.16	5.17
January 22, 1894	11.32	4.55	25.18	7.48	45.93	5.54
February 23, 1894	10.90	4.87	24.62	7.77	46.70	5.14
April 4, 1894	10.95	4.81	25.18	7.19	46.84	5.03
June 16, 1894	10.56	4.52	26.06	7.02	48.35	3.49
August 22, 1894	9.88	4.61	25.94	7.25	48.38	3.94
October 20, 1894	9.84	4.29	25.35	7.11	48.97	4.44
December 31, 1894	12.54	4.10	24.19	7.49	48.58	3.10
February 4, 1895	14.15	4.19	23.44	7.38	48.32	2.52
April 30, 1895	11.67	4.17	27.44	7.37	47.15	2.20
June 11, 1895	10.76	4.18	26.62	7.21	47.79	3.44
Average	11.2	4.4	24.6	7.2	48.5	4.1
Mixed grains, fed steers 3 and 4:						
Lot mixed August 25, 1893	12.79	3.20	11.75	3.84	63.78	4.64
December 20, 1893	12.39	2.70	11.90	4.42	64.34	4.25
February 23, 1893	11.94	3.39	11.50	4.71	64.01	4.45
April 4, 1893	11.65	3.35	12.68	4.87	62.80	4.65
June 16, 1893	11.02	3.30	11.87	4.62	66.43	2.76
August 22, 1893	10.47	2.91	12.25	4.26	65.44	4.67
October 20, 1893	10.34	2.50	12.06	3.91	66.91	4.28
Average	11.5	3.1	12.00	4.4	64.8	4.2

The digestion coefficients used are stated below and are the averages of German and American results in the case of the corn meal and linseed meal, and the American averages alone for the bran, hay and silage. The coefficients for the mixtures are calculated from the coefficients of the single grains.

TABLE XXV.

	Digestion Coefficients.			
	Protein.	Fiber.	Carbo-hydrates.	Fats.
Hay—average for Timothy, all kinds	49	53	63	57
Corn fodder and silage, field corn	63	75	77	83
Southern corn	49	71	66	75
Grain mixture, Steers 1 and 2	80	50	78	85
Steers 3 and 4	73	47	85	82

EFFECT OF THE TWO RATIONS UPON THE INCREASE OF LIVE WEIGHT.

The grain mixtures which the steers received were in the following proportions:

Steers 1 and 2.	Steers 3 and 4.
Linseed meal, 2 parts.	Corn meal, 2 parts.
Corn meal, 1 part.	Wheat bran, 1 part.
Wheat bran, 1 part,	

The coarse foods consisted of hay, with more or less silage during the first winter.

The quantities of grain fed daily were alike for all steers, excepting slight differences during the first few weeks. The amounts of coarse foods eaten daily differed somewhat with the several animals being least for Steer 1, most for Steer 2 and alike for steers 3 and 4.

From the preceding data have been calculated the quantities of food and amounts of dry and digestible material consumed by the several steers.

This has been done not only for the entire time that the steers were fed, but also for the first fifteen months in periods of three months each. There is shown also the nutritive ratios of the rations and the relations between food consumed and thegain in live weight.

The tables which immediately follow are as follows:

Table XXVI to XXIX. The foods eaten and gains of live weight by periods of four to six weeks for the entire experiment.

Table XXX. Summary of Tables 1 to 4.

Table XXXI. Dry matter and digestible matter eaten by the four steers during the entire experiment, with relation of food to growth.

Table XXXII. Summary of Table VI.

Table XXXIII. Dry and digestible matter eaten by the four steers during the first fifteen months of the experiment, considered in five periods, with relation of food to growth.

Table XXXIV. Daily food consumption and growth of steers during first fifteen months of the experiment, considered in five periods.

TABLE XXVI.

FOODS EATEN AND GAINS OF LIVE WEIGHT.—ENTIRE EXPERIMENT.

STEER 1.

Dates.	No. of days.	Food Eaten.			Weight.		
		Hay—pounds.	Silage or corn fodder—pounds.	Grain mixture—pounds.	Initial—pounds.	End—lbs.	Grain—pounds.
1893, September 1—28	28	.....	*616	81.5	221	257	36
September 28—October 26	28	109	*214	45.5	257	279	22
October 26—November 30	35	228	....	81.5	279	327	48
November 30—December 28	28	196	....	82	327	363	36
December 28—January 25	28	136	†300	98	363	397	34
1894, January 25—February 22	28	56	†700	111	397	447	50
February 22—March 29	35	70	‡875	140	447	514	67
March 29—April 26	28	56	‡608	112	514	544	30
April 26—May 31	35	148	†860	140	544	630	86
May 31—June 28	28	280	....	112	630	681	51
June 28—July 26	28	280	....	112	681	707	26
July 26—September 6	42	420	....	198	707	758	51
September 6—October 4	28	280	....	140	758	803	45
October 4—November 1	28	280	....	144	803	851	48
November 1—December 6	35	350	....	249	851	903	52
December 6—January 3	28	280	....	224	903	935	32
1895, January 3—January 28	24½	245	....	196	935	958	23
Totals	514.5	3,414	4,173	2,211	......	......	737

* Field corn. † Southern corn silage. ‡ Field corn silage.

TABLE XXVII.

FOOD EATEN AND GAINS OF LIVE WEIGHT—ENTIRE EXPERIMENT.

STEER 2.

DATES.	No. of days.	FOOD EATEN.			WEIGHTS.		
		Hay—lbs.	Corn fodder or silage—pounds.	Mixed grains—pounds.	Initial—pounds.	End—lbs.	Gain—lbs.
1893, September 1—28	28	......	*963	26.5	345	398	53
September 28—October 26	28	147	*315	43.5	398	434	36
October 26—November 30	35	280	....	81.5	424	451	27
November 30—December 28	28	224	....	61	451	482	31
December 28—January 25	28	161	†300	98	482	512	30
1894, January 25—February 22	28	84	†760	111	512	563	51
February 22—March 29	35	105	‡875	140	563	625	62
March 29—April 26	28	88	‡700	112	625	675	50
April 26—May 31	35	183	†875	140	675	749	74
May 31—June 28	28	308	....	112	749	782	33
June 28—July 26	28	308	....	112	782	812	30
July 26—September 6	42	462	....	196	812	860	48
September 6—October 4	28	308	....	140	860	897	37
October 4—November 1	28	308	....	144	897	920	23
November 1—December 6	35	385	....	249	920	958	38
December 6—January 3	28	308	....	224	958	987	29
1895, January 3—January 31	28	308	....	224	987	1,023	36
January 31—February 28	28	308	....	224	1,023	1,040	17
February 28—March 28	28	308	....	224	1,040	1,075	35
March 28—April 25	28	308	....	224	1,075	1,105	30
April 25—May 30	35	385	....	280	1,105	1,140	35
May 30—June 27	28	308	....	224	1,140	1,158	18
June 27—August 1	35	385	....	280	1,158	1,185	27
August 1—August 29	28	308	....	224	1,185	1,223	38
August 29—September 26	28	369	....	224	1,223	1,255	32
September 26—October 31	35	455	....	280	1,255	1,268	13
October 31—November 28	28	364	....	224	1,268	1,307	39
November 28—December 23	24½	318½	....	196	1,307	1,300	—7
Totals	843.5	7783.5	4,728	4,818.5	......	... .	960

* Field corn. † Southern corn silage. ‡ Field corn silage.

TABLE XXVIII.

FOODS EATEN AND GAINS OF LIVE WEIGHT—ENTIRE EXPERIMENT.

STEER 3.

DATES.	No. of days.	FOOD EATEN.			WEIGHTS.		
		Hay—lbs.	Corn fodder or silage—pounds.	Grain mixture—pounds.	Initial—pounds.	End—lbs.	Gain—pounds.
1893, September 1—September 28......	28	.. ..	*782	29	285	309	24
September 28—October 26	28	128	*261.5	45.5	309	331	22
October 26—November 30.........	35	245	....	81.5	331	361	30
November 30—December 28. ...	28	196	....	82	361	389	28
December 28—January 25	28	136	†300	96	389	410	21
1894, January 25—February 22	28	56	†700	111	410	453	43
February 22—March 29...........	35	70	‡875	140	453	509	56
March 29—April 26	28	56	‡700	112	509	559	50
April 26—May 31	35	148	†875	140	559	621	62
May 31—June 28.	28	280	....	112	621	661	40
June 28—July 26...................	28	280	....	112	661	701	40
July 26—September 6	42	420	....	168	701	750	49
September 6—October 4	28	280	....	140	750	780	30
October 4—November 1..........	28	280	....	144	780	801	21
November 1—December 6........	35	350	....	249	801	862	61
December 6—January 3	28	280	....	224	862	875	13
1895, January 3—January 31............	28	280	....	224	875	913	38
January 31—February 28	28	280	....	224	913	950	37
February 28—March 28	28	280	....	224	950	994	44
March 28—April 25...	28	280	....	224	994	1,036	42
April 25—May 30	35	350	....	280	1,036	1,080	44
May 30—June 27.................	28	280	....	224	1,080	1,114	34
June 27—August 1...........	35	350	... .	280	1,114	1,127	13
August 1—August 29	28	280	....	224	1,127	1,163	36
August 29—September 26.........	28	332	... .	224	1,163	1,208	45
September 26—October 31	35	420	....	280	1,208	1,248	40
October 31—November 28.........	28	336	....	224	1,248	1,290	42
November 28—December 10......	11½	138	....	92	1,290	1,280	10
Totals	333.5	6,811	4,493.55	4,737	......	.....	1,015

* Field corn. † Southern corn silage. ‡ Field corn silage.

TABLE XXIX.

FOODS EATEN AND GAINS OF LIVE WEIGHT—ENTIRE EXPERIMENT.

STEER 4.

DATES.	No. of days.	FOOD EATEN.			WEIGHTS.		
		Hay—lbs.	Fodder or silage—pounds.	Mixed grains—pounds.	Initial—pounds.	End—pounds.	Gain—pounds.
1893, September 1—September 28......	28	......	*763	29.5	318	338	20
September 28—October 26	28	128	*256	35.5	338	366	28
October 26—November 30.... ...	35	245	....	81.5	366	385	19
November 30—December 28......	28	196	....	82	385	401	16
December 28—January 25	28	136	†800	98	401	424	23
1894, January 25—February 22.........	28	56	†700	111	424	468	44
February 22—March 29	35	70	‡875	140	468	525	57
March 29—April 26................	28	56	‡700	112	525	573	48
April 26—May 31	35	148	†875	140	573	628	55
May 31—June 28................ .	28	280	....	112	628	680	52
June 28—July 26.	28	280	....	112	680	702	22
July 26—September 6.....	42	420	....	198	702	725	23
September 6—October 4	28	280	....	140	725	738	13
October 4—November 1...........	28	280	....	144	738	776	38
November 1—December 6.... ...	35	350	....	249	776	815	39
December 6—January 3	28	280	....	224	815	846	31
1895, January 3—January 31............	28	280	....	224	846	894	48
January 31—February 4	35	35	....	28	894	870	24
Totals.........	5,215	3,520	4,469	2,255.5			600

* Field corn. † Southern corn silage. ‡ Field corn silage.

TABLE XXX.

SUMMARY SHOWING TOTALS OF FOODS EATEN AND GAINS MADE BY THE FOUR STEERS DURING ENTIRE EXPERIMENT.

	LOT 1. PROTEIN—RICH FOOD.		LOT 2. PROTEIN—POOR FOOD.	
	Steer 1.	Steer 2.	Steer 3.	Steer 4.
Number of days fed	514	843	833	521
Total hay eaten—pounds	3,414	7,783	6,811	3,520
Total fodder and silage eaten—pounds	4,178	4,728	4,493	4,469
Total mixed grains eaten—pounds	2,211	4,818	4,737	2,255
Total food eaten—pounds	9,700	17,329	16,041	10,234
Initial weights of steers—pounds	221	345	285	318
End weights of steers—pounds	958	1,307	1,290	870
Total gain of each steer—pounds	737	962	1,005	552

TABLE XXXI.

DRY MATTER AND DIGESTIBLE MATTER EATEN BY THE FOUR STEERS DURING THE ENTIRE EXPERIMENT, WITH RELATION OF FOOD TO GROWTH.

	Dry Matter Eaten.				Digestible Matter Eaten.					
	Protein—pounds.	Carbo-hydrates—pounds.	Fat—pounds.	Total—pounds.	Protein—pounds.	Carbo-hydrates—pounds.	Fat—pounds.	Total—pounds.	Nutritive ratio.	Digestible matter eaten for each lb. gain of live w't.
Protein—rich ration.										Lbs.
STEER 1.										
In silage, 4,173 pounds .	89.0	580.6	19.0	698.6	51.4	431.3	15.2	497.9		
In hay, 3,414 pounds...	230.7	2499.4	99.3	2829.4	113.0	1476.9	56.7	1646.6		
In grains, 2,211 pounds.	568.0	1290.2	103.3	1961.5	454.3	961.2	87.8	1503.3		
Total in 514 days....	887.7	4380.2	221.6	5489.5	618.7	2869.4	159.7	3647.8	......	4.96
Eaten daily.............	1.73	8.52	.43	10.78	1.20	5.58	.32	7.10	1:5.2	
Protein—Poor ration.										
STEER 4.										
In silage, 4,469 pounds .	96.0	635.8	20.5	752.3	55.1	465.6	16.4			
In hay, 3,520 pounds...	237.6	2577.3	102.4	2917.3	116.0	1522.7	57.9			
In grains, 2,255 pounds.	272.9	1553.5	96.6	1923.0	199.2	1275.5	79.2			
Total in 521 days....	606.5	4766.6	219.5	5592.6	370.3	3263.8	153.5	3787.6	.. ...	6.86
Eaten daily	1.16	9.15	.42	10.73	.71	6.26	.30	7.27	1:9.7	
Protein—rich ration.										
STEER 2.										
In silage, 4,728 pounds .	102.2	675.6	21.7	799.5	59.7	487.9	17.4	565.0		
In hay, 7,783 pounds....	526.1	5698.1	226.6	6450.8	257.5	3366.9	129.2	3753.6		
In grains, 4,818 pounds.	1185.2	2685.3	205.1	4075.6	948.2	1997.9	174.3	3120.4		
Total in 843 days....	1813.5	9059.0	453.4	11325.9	1265.4	5852.7	320.9	7439.0	......	7.73
Eaten daily	2.15	10.74	.54	13.43	1.50	6.95	.38	8.83	1:5.2	
Protein—poor ration.										
STEER 3.										
In silage, 4,493 pounds .	96.6	639.5	20.6	756.7	56.1	468.4	16.5	541.0		
In hay, 6,811 pounds....	460.4	4986.3	198.8	5645.5	225.3	2946.4	113.0	3284.7		
In grains, 4,737 pounds.	573.0	3284.8	201.4	4059.2	418.3	2713.6	165.2	3297.1		
Total in 833 days....	1130.0	8910.6	420.8	10461.4	699.7	6128.4	294.7	7122.8	......	7.68
Eaten daily..	1.36	10.69	.50	12.55	.84	7.36	.35	8.55	1:9.7	

TABLE XXXII.

SUMMARY OF TABLE XXXI.

	Daily gain in live weight—pounds.	Dry Matter Eaten Daily.				Digestible Material Eaten Daily.				Nutritive ratio.	Digestible matter eaten for each pound gain of live weight—pounds.
		Protein—pounds.	Carbo-hydrates—pounds.	Fats—pounds.	Total—pounds.	Protein—pounds.	Carbo-hydrates—pounds.	Fats—pounds.	Total—pounds.		
Protein—rich food.											
Steer 1, fed 514 days ...	1.43	1.78	8.52	.43	10.73	1.20	5.58	.32	7.10	1:5.2	4.95
Steer 2, fed 843 days ...	1.14	2.15	10.74	.54	13.43	1.50	6.95	.38	8.83	1:5.2	7.73
Protein—poor food.											
Steer 3, fed 521 days ...	1.06	1.16	9.15	.42	10.73	.71	6.26	.30	7.27	1:9.7	6.86
Steer 4, fed 833 days ...	1.20	1.36	10.69	.50	12.55	.84	7.36	.35	8.55	1:9.7	7.08

TABLE XXXIII.

DRY AND DIGESTIBLE MATTER EATEN BY THE FOUR STEERS, DURING THE FIRST FIFTEEN MONTHS OF THE EXPERIMENT, CONSIDERED IN FIVE PERIODS, WITH RELATION OF FOOD TO GAIN.

	DRY MATTER CONSUMED IN ENTIRE PERIODS.				DIGESTIBLE MATTER CONSUMED IN ENTIRE PERIODS.					
	Protein—pounds.	Carbohydrates—pounds.	Fat—pounds.	Total—pounds.	Protein—pounds.	Carbohydrates—pounds.	Fat—pounds.	Total—pounds.	Total gain in period—pounds.	Digestible food eaten per pound of gain—pounds.
Period 1. 91 days—Sept. 1 to Nov. 30, 1893.										
Steer 1	73.4	469.0	23.0	565.4	48.3	314.6	16.7	379.6	106	3.58
Steer 2	89.5	601.5	27.6	718.6	57.4	405.0	19.9	482.3	106	4.55
Steer 3	68.5	538.92	23.4	630.8	41.4	371.4	16.5	429.3	76	5.65
Steer 4	66.8	528.7	22.8	618.3	40.3	363.2	17.1	420.6	67	6.28
Period 2. 84 days—Dec. 1 to Feb. 22, 1894.										
Steer 1	109.1	574.9	31.2	715.2	73.5	377.9	22.9	474.3	120	3.95
Steer 2	114.5	634.2	33.5	782.2	76.2	412.8	24.3	513.3	112	4.58
Steer 3	78.3	606.2	29.0	713.5	46.5	415.7	20.7	482.9	92	5.25
Steer 4	78.3	606.2	29.0	713.5	46.5	415.7	20.7	482.9	83	5.82
Period 3. 96 days—Feb. 23 to May 31, 1894.										
Steer 1	167.6	749.8	38.6	956.0	117.4	524.2	30.1	671.7	183	3.67
Steer 2	117.0	840.5	42.1	1059.6	122.4	579.8	32.2	724.4	186	3.94
Steer 3	120.7	820.2	37.1	978.0	76.1	607.7	29.5	713.3	168	4.25
Steer 4	120.7	820.2	37.1	978.0	76.1	607.7	29.5	713.3	160	4.46
Period 4. 96 days—June 1 to Sept. 6, 1894.										
Steer 1	174.1	946.6	44.8	1165.5	118.7	594.5	30.1	743.3	128	5.80
Steer 2	180.7	1018.4	47.6	1246.7	121.9	636.8	31.7	790.4	111	7.11
Steer 3	117.0	1009.9	42.2	1169.1	69.5	665.1	27.5	762.1	129	5.90
Steer 4	117.0	1009.9	42.2	1169.1	69.5	665.1	27.5	762.1	97	7.85
Period 5. 91 days—Sept. 7 to Dec. 6, 1894.										
Steer 1	198.3	963.8	48.5	1210.6	139.6	615.2	33.8	788.6	145	5.44
Steer 2	204.5	1030.8	51.1	1286.4	142.6	654.5	35.3	832.4	98	8.50
Steer 3	126.3	1029.1	50.6	1206.0	77.4	693.7	34.9	806.0	112	7.20
Steer 4	126.3	1029.1	50.6	1206.0	77.4	693.7	34.9	806.0	90	8.96

TABLE XXXIV.

DAILY FOOD CONSUMPTION AND GROWTH OF STEERS DURING FIRST FIFTEEN MONTHS OF THE EXPERIMENT, CONSIDERED IN FIVE PERIODS.

		Dry Matter Consumed Daily.				Digestible Matter Consumed Daily.				
		Protein—pounds.	Carbo-hydrates—pounds.	Fat—pounds.	Total—pounds.	Protein—pounds.	Carbo-hydrates—pounds.	Fat—pounds.	Total—pounds.	Daily gain in live weight—pounds.
Period 1. 91 days. September 1 to November 30, 1893.										
More protein in ration	Steer 1....	.81	5.15	.25	6.21	.53	3.46	.18	4.17	1.16
	Steer 2....	.98	6.61	.30	7.90	.63	4.45	.22	5.30	1.16
Less protein in ration	Steer 3....	.75	5.92	.25	6.93	.45	4.08	.18	4.72	.83
	Steer 4....	.73	5.82	.25	6.80	.44	4.00	.18	4.62	.78
Period 2. 84 days. December 1 to February 22, 1894.										
More protein in ration	Steer 1....	1.30	6.84	.36	8.59	.87	4.50	.27	5.64	1.43
	Steer 2...	1.36	7.55	.40	9.31	.91	4.91	.30	6.11	1.33
Less protein in ration	Steer 3....	.93	7.22	.34	8.49	.55	4.95	.24	5.74	1.10
	Steer 4. ..	.93	7.22	.34	8.49	.55	4.95	.24	5.74	.99
Period 3. 98 days. February 23 to May 31, 1894.										
More protein in ration	Steer 1....	1.71	7.65	.40	9.76	1.19	5.35	.31	6.85	1.87
	Steer 2....	1.81	8.59	.43	10.81	1.25	5.91	.33	7.49	1.90
Less protein in ration	Steer 3....	1.23	8.37	.38	9.98	.77	6.20	.30	7.27	1.71
	Steer 4....	1.23	8.37	.38	9.98	.77	6.20	.30	7.27	1.63
Period 4. 98 days. June 1 to September 6, 1894.										
More protein in ration	Steer 1...	1.77	9.66	.45	11.88	1.21	6.06	.30	7.57	1.31
	Steer 2 ..	1.84	10.40	.48	12.72	1.24	6.50	.32	8.06	1.13
Less protein in ration	Steer 3....	1.20	10.30	.43	11.93	.71	6.78	.28	7.77	1.31
	Steer 4....	1.20	10.30	.43	11.93	.71	6.78	.28	7.77	1.00
Period 5. 91 days. September 7 to December 6, 1894.										
More protein in ration	Steer 1....	2.18	10.59	.53	13.30	1.53	6.76	.37	8.66	1.62
	Steer 2 ...	2.24	11.33	.56	14.13	1.57	7.19	.39	9.14	1.10
Less protein in ration	Steer 3....	1.38	11.31	.55	13.24	.85	7.62	.38	8.85	1.25
	Steer 4....	1.38	11.31	.55	13.24	.85	7.62	.38	8.85	1.00

In order to clearly present the facts relative to the comparative effects of the two rations upon the growth of the steers, as shown by the preceding figures, it is desirable to first review briefly the history of the experiment.

Two pairs of steers were fed, one pair receiving a ration with a nutritive ratio of about 1:5.2 and the other pair, a ration with a much wider nutritive ratio, or one of about 1:9.7. When the experiment had progressed for about seventeen months, one steer from each pair was taken out and slaughtered, and the other two steers were fed for ten months longer. The rations were weighed daily and the steers weekly, and the silage and grains were analyzed, so that it is possible to consider the relations of food growth during the entire experiment or any part of it.

If we consult the foregoing figures we see very clearly that the two rations were quite unlike in their effect during the early stages of the experiment, the nitrogenous ration producing much the larger amount of growth.

As the steers became older and the rations increased in quantity, the difference in the rates of growth produced by the two rations was somewhat less marked, until, at the age of seventeen months, the growth of the two pairs was not greatly unlike.

TABLE XXXV.

	Weight pair fed more protein—pounds.	Weight pair fed less protein—pounds.	Greater weight of protein fed pair—pounds.	Increase of difference in weight.
At beginning of experiment	566	603	—37	
At end of three months	778	746	+32	69
At end of six months	1,010	921	+89	57
At end of nine months	1,379	1,249	+130	41
At end of twelve months	1,618	1,475	+143	13
At end of fifteen months	1,861	1,677	+184	41
At end of seventeen months	1,981	1,807	+174	—10

Not only do the above figures plainly indicate the superiority for the young animals of the ration richer in protein, but the same fact was made very evident by the general condition of the steers. Steers 1 and 2 had an appearance of greater thrift than steers 3 and 4 which was unmistakable.

The superiority of the protein rich over the protein-poor ration during the first year of growth is shown emphatically, also, by the difference in digestible dry matter required in the two cases to produce a pound of growth.

TABLE XXXVI.

DIGESTIBLE MATTER REQUIRED TO PRODUCE ONE POUND OF GROWTH.

	Steers fed more protein.	Steers fed less protein.
During first three months	4.06	5.96
During second three months	4.96	5.53
During third three months	3.83	4.35
During fourth three months	6.45	6.87
During fifth three months	6.97	8.08
Average	5.11	6.16

After two animals were slaughtered at the end of seventeen months, the later results with the other two animals at greater age were not the same. These latter steers were fed ten months longer than the others and during that time the steer eating the ration richer in protein gained 284 pounds and the steer receiving the larger proportion of carbohydrate food gained 377 pounds, a difference in favor of the latter of 93 pounds.

Nothing can be clearer, than that with the particular animals fed, the superiority of the protein-rich ration over the other diminished as the steers increased in age. In seeking for an explanation of this fact we may not go far amiss if we consider that the amount of digestible matter in an animal's food must reach a certain absolute quantity before any can be spared for the formation of new tissues. If the nutritive ratio is wide the small ration of the very young animal supplies so little protein that the quantity is inadequate to meet the demands of the possible active growth of that period of life. When, however, the ration is increased to the capacity of the older and larger animal the absolute quantity of protein fed, even in a wide-ratio ration, is sufficient for a generous growth of tissue. It should be remembered that an animal's capacity for growth does not increase proportionately with the age and weight, or so rapidly as does the capacity for food consumption, consequently with an unvarying nutritive ratio the protein supply is likely to be more nearly adequate with the two-year-old steer than with the yearling. It has been the opinon of the writer for some time that the standard rations known as German rations are entirely consistent with facts in at least two particulars:

1st. They call for a diminishing proportion of protein in the ration of growing animals as the animals proceed toward maturity.

2nd. They call for a larger proportion of protein in the ration of the milch cow than in that of the somewhat mature steer.

We believe that the experiment under discussion gives evidence that tends to substantiate this opinion.

THE INFLUENCE OF THE RATIONS UPON THE COMPOSITION OF THE BODIES OF THE STEERS.

When this experiment was planned it was determined to undertake the somewhat arduous task of making a chemical analysis of the entire bodies of the experimental steers, the purpose of this costly piece of work being to determine whether the composition of their bodies was materially modified by the proportions of nutrients in the food. This plan was carried out and the organs and carcasses of the four animals were analyzed, the only part omitted being the skin and hair. These are believed to be the only fairly complete analyses of the bodies of mature bovines since those made by Lawes & Gilbert nearly forty years ago, whose results were published in 1858.

Separation of parts, sampling and analyses. When the steers were killed the blood was caught in a tub which was set under a small trap door in the floor. The animals were then dressed and the various organs and parts were weighed as soon as removed, the carcasses being also weighed in the green condition.

The various organs and divisions of the body were taken to the laboratory and sampled for analysis as rapidly as the work could be performed. It was not over forty-eight hours after the animals were killed before the samples of all the various parts were secured and in the process of drying.

The manner of obtaining the samples was as follows: In the case of the organs such as the heart, liver, lungs, &c., they were minced very fine by being run through a power Enterprise Meat Chopper. This minced material was thoroughly mixed and then large samples were selected for drying. The flesh of the right side of each carcass was entirely removed from the bones, the muscular tissues and the adipose tissues being separated mechanically as fully as possible and thrown into separate dishes. Both the lean portions and the fat were entirely passed through the meat chopper, large samples being selected from each portion for drying. The lean meat samples were dried and the samples of fat were bottled without drying in air tight jars and kept very cold until analysis. The intestinal and kidney fats were treated in the same way as the body fat.

The samples were brought to an air-dry condition in a drying closet heated by a coil of steam pipe, the temperature of which varied from 50 to 60 degrees C., or 120 to 140 degrees F.

The air-dry samples were finally prepared for analysis by passing them through a mill. The samples of fat which were enclosed in jars without previous drying were submitted to analysis in the fresh condition, the amount of water in adipose tissue being so small as to allow this. For the determination of the fat in these latter materials by extraction with either, unusually large portions were used, approximately 20 grams, and several single determinations were made from such samples. In fact this precaution was taken in every case where the sample contained so much fat as to render the sampling less perfect than was desirable. The percentages of protein given are those obtained "by difference."

Having then the weights of the various organs and parts of the animals and knowing from analysis their percentage composition, it became possible to calculate the proportions of water, ash, protein and fats in the entire animals as well as in the several divisions of the body.

In the tables which immediately follow are displayed very fully the facts which appear from these mechanical and chemical analyses.

Table XXXVII. Weights of the various organs and parts of the steers' bodies.

Table XXXVIII. Composition of the organs and parts of the steers' bodies in the fresh condition.

Table XXXIX to XLII. Composition of the water-free substance of the organs and parts of the steers' bodies with the calculated weights of ash, protein and fat in the same.

Table XLIII. Composition of the entire bodies of the steers, exclusive of skin and contents of stomach and intestines.

Tables XLIV to XLVII. Composition of the carcasses of the steers.

Tables XLVIII to LI. Composition of the edible portion of the carcasses of the steers.

Table LII. Summary of Tables XLIV to XLVII.

Table LIII. Summary of Tables XLVIII to LI.

Table LIV. Proportions of edible materials in the carcasses of the steers.

Table LV. Summary Table LIV.

Table LVI. Proportions of non-edible material in the entire bodies of steers.

Table LVII. Composition of increased growth of older steers.

TABLE XXXVII.

WEIGHTS OF THE VARIOUS PARTS OF STEERS, IN FRESH CONDITION.

	PROTEIN—RICH RATION.		PROTEIN—POOR RATION.	
	Steer 1—pounds.	Steer 2—pounds.	Steer 3—pounds.	Steer 4—pounds.
Live weight	958.0	1,300.0	1,230.0	870.0
External refuse:				
Skin	78.6	96.0	92.5	64.7
Head	29.9	32.5	34.0	26.5
Feet	18.5	22.9	20.6	15.6
Internal refuse:				
Stomach	25.8	35.7	26.5	23.7
Contents of stomach	126.4	160.8	178.5	91.4
Small intestine	15.4	10.1	9.6	12.6
Large intestine	......	9.1	7.0	
Contents of small intestine	23.2	12.9	15.4	26.5
Contents of large intestine	....	17.7	23.7	
Intestinal fat	22.3	40.4	34.5	19.9
Organs:				
Tongue	3.7	4.5	4.5	2.9
Lungs and trachea	6.4	8.9	13.0	7.0
Heart and attachments	6.9	11.7	5.6	5.1
Liver	10.3	12.5	10.7	9.3
Kidneys	1.8	2.5	2.0	1.9
Kidney fat	15.3	22.8	21.4	15.1
Pancreas	1.1	.9	.9	1.1
Spleen	1.4	1.9	2.0	1.5
Bladder, etc	.4	1.3	1.2	.5
Diaphragm	2.6	3.9	4.6	2.9
Gall bladder and contents	.9	.6	.4	.6
Blood	34.3	49.8	46.3	38.3
Fore quarter, right side	127.6	173.5	175.0	123.2
Hind quarter, right side	146.9	195.0	195.0	131.4
Fore quarter, left side	278.7	165.0	162.5	259.2
Hind quarter, left side	....	207.0	200.0	
Whole carcass	553.2	740.5	732.5	513.8

TABLE XXXVIII.

COMPOSITION OF THE ORGANS AND PARTS OF THE STEERS' BODIES, IN THE FRESH CONDITION.

EXTERNAL REFUSE.		Water—per cent.	Water-free substance—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.
Lean meat of head	Steer 1	67.04	32.96	18.26	13.79	.91
	Steer 2	68.38	31.62	17.88	12.76	1.08
	Steer 3	69.30	30.7	18.31	11.43	.96
	Steer 4	80.27	19.73	11.73	7.40	.60
Fat of head	Steer 1	20.40	79.60	14.61	64.50	.49
	Steer 2	8.40	91.60	27.34	63.68	.58
	Steer 3	10.90	89.10	19.70	68.38	1.02
	Steer 4	31.80	68.20	10.67	57.04	.49
Bones of head	Steer 1	18.91	81.09	35.25	13.33	32.51
	Steer 2	25.10	74.90	23.87	19.22	31.81
	Steer 3	24.70	75.30	26.34	18.59	30.37
	Steer 4	16.10	83.90	30.01	16.37	37.52
Feet	Steer 1	32.23	67.77	35.71	11.24	20.82
	Steer 2	32.60	67.40	35.55	9.29	22.56
	Steer 3	37.40	62.60	29.99	11.41	21.20
	Steer 4	31.30	68.70	33.53	14.36	20.79
INTERNAL REFUSE.						
Stomachs	Steer 1	75.68	24.32	13.91	9.49	.91
	Steer 2	72.62	27.38	14.62	11.09	1.67
	Steer 3	73.80	26.20	12.65	12.00	1.55
	Steer 4	74.55	25.45	13.40	10.84	1.21
Large intestines	Steer 2	72.69	27.31	9.01	16.89	1.41
	Steer 3	68.97	31.03	11.76	18.38	.89
Small intestines	Steer 2	44.00	56.00	16.25	37.91	1.79
	Steer 3	82.66	17.34	6.64	10.08	.62
Large and small intestines	Steer 1	78.70	21.30	8.03	12.53	.74
	Steer 4	74.37	25.63	11.43	13.02	1.18
Intestinal fat	Steer 1	9.60	90.40	3.29	86.90	.21
	Steer 2	6.40	93.60	2.19	91.28	.13
	Steer 3	5.90	94.10	4.32	89.68	.10
	Steer 4	10.40	89.60	3.68	85.74	.18
Blood	Steer 1	81.83	18.17	17.26	.10	.81
	Steer 2	82.70	17.30	16.46	.08	.76
	Steer 3	80.62	19.38	18.55	.11	.72
	Steer 4	82.38	17.62	16.82	.10	.70
Bladder	Steer 1	61.00	39.00	28.03	9.77	1.20
	Steer 2	65.29	34.71	18.02	15.86	.83
	Steer 3	62.52	37.48	16.26	20.49	.73
	Steer 4	74.22	25.78	19.80	5.11	.87
Diaphragm	Steer 1	61.50	38.50	18.18	19.52	.80
	Steer 2	47.20	52.80	17.43	34.56	.81
	Steer 3	52.94	47.06	16.87	29.60	.59
	Steer 4	53.36	46.64	17.10	28.81	.73
Thorax fat	Steer 1	22.67	77.33	6.84	70.10	.39
	Steer 4	18.90	81.10	7.98	72.81	.31
Heart attachments	Steer 1	40.70	59.30	9.57	49.23	.50

TABLE XXXVIII—CONCLUDED.

COMPOSITION OF THE ORGANS AND PARTS OF THE STEERS' BODIES, IN THE FRESH CONDITION.

ORGANS.		Water—per cent.	Water-free substance—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.
Tongue	Steer 1	68.94	31.06	16.90	13.27	.89
	Steer 2	61.63	38.37	15.40	22.22	.75
	Steer 3	64.03	35.97	15.17	19.91	.89
	Steer 4	65.80	34.20	16.68	16.57	.95
Liver	Steer 1	71.28	28.72	23.18	4.00	1.54
	Steer 2	69.37	30.63	23.93	4.99	1.71
	Steer 3	72.01	27.99	22.55	3.94	1.50
	Steer 4	70.24	29.76	23.86	4.17	1.73
Heart	Steer 1	69.11	30.89	15.17	14.70	1.02
	Steer 2	52.58	47.42	13.76	33.05	.61
	Steer 3	56.26	43.74	18.53	24.37	.84
	Steer 4	60.05	39.95	12.37	26.89	.69
Lungs and trachea	Steer 1	78.15	21.85	17.10	3.65	1.10
	Steer 2	52.65	47.35	33.23	11.55	2.57
	Steer 3	66.21	33.79	15.87	17.01	.91
	Steer 4	77.06	22.94	15.80	5.74	1.40
Kidneys	Steer 1	75.02	24.98	15.44	8.27	1.27
	Steer 2	75.83	24.17	14.95	8.13	1.09
	Steer 3	78.26	21.74	14.70	5.83	1.21
	Steer 4	76.97	23.03	15.52	6.36	1.15
Pancreas	Steer 1	64.58	35.42	16.26	17.69	1.47
	Steer 2	67.76	32.24	16.35	13.82	2.07
	Steer 3	68.63	31.37	14.79	14.91	1.67
	Steer 4	67.83	32.17	16.06	14.60	1.50
Spleen	Steer 1	76.12	23.88	17.38	5.03	1.47
	Steer 2	76.78	23.22	17.56	4.08	1.58
	Steer 3	75.63	24.37	16.29	6.80	1.28
	Steer 4	76.41	23.59	18.48	3.61	1.50

TABLE XXXIX.

COMPOSITION OF WATER-FREE SUBSTANCE OF PARTS OF STEERS' BODIES, WITH WEIGHTS OF ASH, PROTEIN AND FAT.

STEER 1.

	Water-free substance—pounds.	Composition of Water-Free Substance.			Weights of		
		Protein—per cent.	Fat—per cent.	Ash—per cent.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean meat of head, exclusive of tongue,	3.6	55.4	41.8	2.8	1.99	1.51	.10
Fat of head	.9	18.3	81.1	.6	.16	.73	.01
Bones of head	8.7	43.5	16.4	40.1	3.79	1.42	3.49
Feet	9.3	52.7	16.6	30.7	4.90	1.54	2.86
Stomachs	6.3	57.2	39.1	3.7	3.60	2.47	.23
Small intestine Large intestine	3.3	37.7	58.8	3.5	1.24	1.94	.12
Intestinal fat	19.6	3.7	96.1	.2	.73	18.83	.04
Diaphragm	1.0	47.2	50.7	2.1	.47	.51	.02
Bladder	.2	71.9	25.0	3.1	.14	.05	.01
Tongue	1.1	54.4	42.7	2.9	.60	.47	.03
Liver	3.0	80.7	13.9	5.4	2.42	.42	.16
Heart and attachments	6.5	18.5	80.3	1.2	1.20	5.22	.08
Lungs and trachea	1.4	78.2	16.7	5.1	1.09	.24	.07
Kidneys	.2	61.8	33.1	5.1	.14	.07	.01
Kidney fat	7.4	1.6	98.3	.1	.11	7.28	.01
Pancreas	.4	45.9	50.0	4.1	.18	.20	.02
Spleen	.3	72.7	21.1	6.2	.22	.06	.02
Blood	6.2	95.0	.6	4.4	5.89	.04	.27
Bones of carcass	26.7	43.5	16.4	40.1	11.61	4.38	10.71
Lean meat of fore quarter, right side	26.2	64.7	32.2	3.1	16.94	8.44	.82
Fat of fore quarter, right side	10.8	8.9	90.7	.4	.96	9.80	.04
Lean meat of hind quart'r, right side	26.7	69.8	26.9	3.3	18.64	7.18	.88
Fat of hind quarter, right side	14.5	5.0	94.7	.3	.73	13.73	.04
*Left side of carcass	114.2	43.7	45.2	11.1	49.91	51.62	12.67
	298.5				127.65	138.15	32.71

* Assumed to have the same composition as the right side.

TABLE XL.

COMPOSITION OF WATER-FREE SUBSTANCE OF STEERS' BODIES, WITH WEIGHTS OF ASH, PROTEIN AND FAT.

STEER 2.

	Water-free substance—pounds.	Composition of Water-Free Substance.			Weights of		
		Protein—per cent.	Fat—per cent.	Ash—per cent.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean meat of head, exclusive of tongue	3.6	56.3	40.4	3.3	2.03	1.45	.12
Fat of head	2.3	29.9	69.5	.6	.69	1.60	.01
Bones of head	12.2	31.9	25.6	42.5	3.89	3.13	5.18
Feet	15.1	52.7	13.8	33.5	7.96	2.08	5.06
Stomachs	9.4	53.4	40.5	6.1	5.02	3.81	.57
Small intestine	5.4	29.0	67.8	3.2	1.57	3.66	.17
Large intestine	2.4	33.0	61.8	5.2	.79	1.48	.12
Intestinal fat	37.3	2.4	97.5	.1	.90	36.37	.04
Diaphragm	2.0	33.0	65.5	1.5	.66	1.31	.03
Bladder	.4	51.9	45.7	2.4	.21	.18	.01
Tongue	1.7	40.1	57.9	2.0	.66	.95	.03
Liver	3.8	78.1	16.3	5.6	2.97	.62	.21
Heart and attachments	3.6	29.0	69.7	1.3	1.04	2.51	.05
Lungs and trachea	4.2	70.2	24.4	5.4	2.95	1.02	.23
Kidneys	.3	61.9	33.6	4.5	.19	.10	.01
Kidney fat	11.1	2.5	97.4	.1	.28	10.81	.01
Pancreas	2.9	50.7	42.9	6.4	1.47	1.24	.19
Spleen	.4	75.6	17.6	6.8	.33	.08	.03
Blood	8.6	95.1	.4	4.4	8.18	.04	.38
Bones of carcass	40.4	31.9	25.6	42.5	12.89	10.34	17.17
Lean meat of fore quarter, right side	34.1	58.1	38.8	3.0	19.85	13.23	1.02
Fat of fore quarter, right side	23.1	10.6	89.0	.4	2.45	20.56	.09
Lean meat of hind quarter, right side	33.8	65.9	30.8	3.3	22.28	10.41	1.12
Fat of hind quarter, right side	34.4	12.9	86.8	.3	4.44	29.86	.10
Left side of carcass	182.5	35.2	53.8	11.0	64.24	98.19	20.07
	475.0				167.94	255.03	52.02

TABLE XLI.

COMPOSITION OF WATER-FREE SUBSTANCE OF STEERS' BODIES, WITH WEIGHTS OF ASH, PROTEIN AND FAT.

STEER 3.

	Water-free substance—pounds.	Composition of Water-Free Substance.			Weights of		
		Protein—per cent.	Fat—per cent.	Ash—per cent.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean meat of head, exclusive of tongue,	3.2	59.7	37.2	3.1	1.91	1.19	.10
Fat of head	3.0	22.1	76.7	1.2	.66	2.30	.00
Bones of head	11.9	35.0	24.7	40.3	4.16	2.94	4.80
Feet	12.9	47.9	18.2	33.9	6.18	2.35	4.37
Stomachs	6.8	48.3	45.8	5.9	3.28	3.11	.40
Small intestine	1.6	38.3	58.1	3.6	.61	.93	.06
Large intestine	2.1	37.9	59.2	2.9	.79	1.24	.06
Intestinal fat	31.5	4.6	95.3	.1	1.45	30.01	.04
Diaphragm	2.1	35.8	62.9	1.3	.75	1.32	.03
Bladder	.4	43.4	54.7	1.9	.17	.22	.01
Tongue	1.6	42.2	55.3	2.5	.67	.89	.04
Liver	3.0	80.6	14.0	5.4	2.42	.42	.16
Heart and attachments	2.9	42.4	55.7	1.9	1.23	1.62	.06
Lungs and trachea	4.2	47.0	50.3	2.7	1.97	2.12	.11
Kidneys	.2	67.6	26.8	5.6	.13	.05	.01
Kidney fat	10.4	2.4	97.5	.1	.25	10.15	.01
Pancreas	.3	47.2	47.5	5.3	.14	.14	.02
Spleen	.5	66.8	27.9	5.3	.33	.14	.02
Blood	9.0	95.7	.6	3.7	8.61	.05	.33
Bones of carcass	44.0	35.0	24.7	40.3	15.39	10.86	17.75
Lean meat of fore quarter, right side	32.6	65.0	31.9	3.1	21.20	10.39	1.01
Fat of fore quarter, right side	25.1	10.0	89.6	.4	2.50	22.50	.10
Lean meat of hind quarter, right side	31.9	69.0	27.6	3.4	22.03	8.80	1.07
Fat of hind quarter, right side	32.8	5.4	94.3	.3	1.78	30.92	.10
Left side of carcass	175.6	35.75	52.92	11.35	62.77	92.93	19.90
	449.6				161.38	237.60	50.56

TABLE XLII.

COMPOSITION OF WATER-FREE SUBSTANCE OF STEERS' BODIES, WITH WEIGHTS OF ASH, PROTEIN AND FAT.

STEER 4.

	Water-free substance—pounds.	COMPOSITION OF WATER-FREE SUBSTANCE.			WEIGHTS OF		
		Protein—per cent.	Fat—per cent.	Ash—per cent.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean meat of head, exclusive of tongue,	1.9	59.4	37·5	3.1	1.13	.71	.06
Fat of head	1.5	15.7	83.6	.7	.23	1.26	.01
Bones of head	8.9	44.7	35.8	19.5	3.98	3.19	1.73
Feet	12.5	48.8	20.9	30.3	6.10	2.62	3.78
Stomachs	6.3	52.6	42.6	4.8	3.32	2.68	.30
Small intestine Large intestine	3.2	44.6	50.8	4.6	1.43	1.62	.15
Intestinal fat	17.9	4.1	95.7	.2	.73	17.13	.04
Diaphragm	1.4	36.7	61.7	1.6	.51	.87	.02
Bladder	.1	76.8	19.8	3.4	.08	.02	.00
Tongue	1.0	48.8	48.4	2.8	.49	.48	.03
Liver	2.8	80.2	14.0	5.8	2.25	.39	.16
Heart and attachments	3.5	14.3	85.1	.6	.50	2.98	.02
Lungs and trachea	1.6	68.9	25.0	6.1	1.10	.40	.10
Kidneys	.2	67.4	27.6	5.0	.13	.06	.01
Kidney fat	7.2	2.6	97.3	.1	.18	7.01	.01
Pancreas	.3	49.9	45.4	4.7	·15	.14	.01
Spleen	.4	78.3	15.3	6.4	.31	.06	.03
Blood	6.8	95.5	.6	3.9	6.49	.04	.27
Bones of carcass	28.1	35.8	19.5	44.7	10.06	5.48	12.54
Lean meat of fore quarter, right side	24.5	64.9	31.9	3.2	15.91	7.81	.78
Fat of fore quarter, right side	11.8	3.9	95.8	.3	.46	11.30	.04
Lean meat of hind quarter, right side	26.9	65.1	31.7	3.2	17.51	8.53	.86
Fat of hind quarter, right side	12.6	8.7	91.0	.3	1.10	11.46	.03
Left side of carcass	113.3	40.77	46.39	12.84	46.20	52.55	14.55
	294.7				120.35	138.79	35.53

TABLE XLIII.

PERCENTAGE COMPOSITION OF ENTIRE BODIES OF STEERS, EXCLUSIVE OF SKIN AND CONTENTS OF STOMACHS AND INTESTINES.

	In Fresh Condition.				In Water-free Substance.		
	Water—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.
Steer 1. Protein-rich ration.	59.37	17.38	18.80	4.45	42.78	46.28	10.94
Steer 2. Protein-rich ration.	53.09	16.59	25.18	5.14	35.37	53.68	10.95
Steer 3. Protein-poor ration.	53.41	16.73	24.62	5.24	35.91	52.84	11.25
Steer 4. Protein-poor ration.	57.13	17.51	20.19	5.17	40.85	47.10	12.05

TABLE XLIV.

COMPOSITION OF RIGHT SIDE OF CARCASS.

STEER 1.

	Weights.		Weights of Constituents.			
	Fresh—pounds.	Water-free—pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	87.81	26.15	61.66	16.92	8.42	.81
Fat of fore quarter	13.24	10.80	2.44	.96	9.80	.04
Lean of hind quarter	94.06	26.70	67.36	18.64	7.18	.88
Fat of hind quarter	17.03	14.50	2.53	.73	13.73	.04
Kidney	.91	.23	.68	.14	.07	.02
Kidney fat	7.57	7.40	.17	.11	7.28	.01
Bones of carcass	32.90	26.70	6.20	11.61	4.88	10.71
Whole side	253.52	112.48	141.04	49.11	50.86	12.51
			%	%	%	%
Percentage composition	....	....	59.02	17.89	18.53	4.56
Percentage composition water-free.	....	....	....	43.66	45.23	11.11

TABLE XLV.

COMPOSITION OF RIGHT SIDE OF CARCASS.

STEER 2.

	WEIGHTS.		WEIGHTS OF CONSTITUENTS.			
	Fresh—pounds.	Water-free pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	109.9	34.1	75.80	19.85	13.23	1.02
Fat of fore quarter	30.3	23.1	7.20	2.45	20.56	.09
Lean of hind quarter	114.9	33.8	81.10	22.28	10.41	1.12
Fat of hind quarter	40.9	34.4	6.50	4.44	29.86	.10
Kidney	1.3	.3	1.00	.19	.10	.01
Kidney fat	11.4	11.1	.30	.28	10.81	.01
Bones of carcass	53.9	40.4	13.50	12.89	10.34	17.17
Whole side	362.6	177.2	185.40	62.38	95.31	19.52
Percentage composition	....	....	% 51.91	% 16.98	% 25.86	% 5.30
Percentage composition water-free	....	......	....	35.20	53.78	11.02

TABLE XLVI.

COMPOSITION OF RIGHT SIDE OF CARCASS.

STEER 3.

	WEIGHTS.		WEIGHTS OF CONSTITUENTS.			
	Fresh—pounds.	Water-free —pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	107.7	32.6	75.10	21.20	10.39	1.01
Fat of fore quarter	31.7	25.1	6.60	2.50	22.49	.10
Lean of hind quarter	110.0	31.9	78.10	22.04	8.80	1.07
Fat of hind quarter	39.5	32.8	6.70	1.78	30.92	.10
Kidney	1.0	.2	.80	.13	.05	.01
Kidney fat	10.7	10.4	.30	.25	10.15	.01
Bones of carcass	58.4	44.0	14.40	15 39	10.86	17.75
Whole side	359.0	177.0	182.00	63.29	93.66	20.05
Percentage composition	....	......	% 52.16	% 17.10	% 25.32	% 5.42
Percentage composition water-free	....	....	....	35.75	52.90	11.35

XLVII.

COMPOSITION OF RIGHT SIDE OF CARCASS.

STEER 4.

	WEIGHTS.		WEIGHTS OF CONSTITUENTS.			
	Fresh—pounds.	Water-free—pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	80.80	24.50	56.30	15.91	7.81	.78
Fat of fore quarter	14.37	11.80	2.57	.46	11.30	.04
Lean of hind quarter	85.42	26.90	58.52	17.51	8.53	.86
Fat of hind quarter	14.27	12.60	1.67	1.10	11.46	.03
Kidneys	.95	.20	.75	.13	.06	.01
Kidney fat	7.49	7.20	.29	.18	6.97	.01
Bones of carcass	33.46	28.10	5.36	10.05	5.48	12.54
Whole side	236.76	111.30	125.46	45.34	51.61	14.27
			%	%	%	%
Percentage composition	....	....	56.30	17.82	20.27	5.61
Percentage composition water-free	....	....	....	40.77	46.39	12.84

TABLE XLVIII.

COMPOSITION OF THE EDIBLE PORTION OF THE CARCASS.

STEER 1.

	WEIGHTS.		WEIGHTS OF CONSTITUENTS.			
	Fresh—pounds.	Water-free—pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	87.8	26.15	61.65	16.92	8.42	.81
Fat of fore quarter	13.3	10.80	2.50	.96	9.80	.04
	101.1	36.95	64.15	17.88	18.22	.85
Percentage composition fore quarter	....	....	% 63.46	% 17.69	% 18.01	% .84
Percentage composition water-free	....	......	....	48.41	49.28	2.31
Lean of hind quarter	94.1	26.7	lbs. 67.4	lbs. 18.64	lbs. 7.18	lbs. .88
Fat of hind quarter	17.0	14.5	2.5	.73	13.73	.04
	111.1	41.2	69.9	19.37	20.91	.92
Percentage composition hind quart'r	....	....	% 62.91	% 17.44	% 18.82	% .83
Percentage composition water-free	....	....	....	47.02	50.75	2.23
Fore quarter	101.1	36.95	lbs. 64.15	lbs. 17.88	lbs. 18.22	lbs. .85
Hind quarter	111.1	41.20	69.90	19.37	20.91	.92
	212.2	78.15	134.05	37.25	39.13	1.77
Percentage composition of side	.... ..	....	% 63.18	% 17.56	% 18.44	% .82
Percentage composition water-free	....	....	... ...	47.66	50.07	2.27

TABLE XLIX.

COMPOSITION OF THE EDIBLE PORTION OF THE CARCASS.

STEER 2.

	WEIGHTS.		WEIGHTS OF CONSTITUENTS.			
	Fresh—pounds.	Water-free—pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	109.9	34.1	75.80	19.85	13.25	1.02
Fat of fore quarter	30.3	23.1	7.20	2.45	20.56	.09
	140.2	57.2	83.00	22.30	33.79	1.11
			%	%	%	%
Percentage composition fore quarter	....	....	59.20	15.90	24.10	.79
Percentage composition water-free .	....	....	....	38.99	59.07	1.94
			lbs.	lbs.	lbs.	lbs.
Lean of hind quarter	114.9	33.8	81.10	22.28	10.41	1.12
Fat of hind quarter.....	40.9	34.4	6.50	4.44	29.86	.10
	155.8	68.2	87.60	26.72	40.27	1.22
			%	%	%	%
Percentage composition hind quart'r	....	....	56.24	17.15	25.85	.76
Percentage composition water-free .	....	... .	....	39.18	59.04	1.78
			lbs.	lbs.	lbs.	lbs.
Fore quarter....	140.2	57.2	83.00	22.30	33.79	1.11
Hind quarter..............................	155.8	68.2	87.60	26.72	40.27	1.22
	296.0	125.4	170.60	49.02	74.06	2.33
			%	%	%	%
Percentage composition of side	....	....	57.63	16.56	25.03	.78
Percentage composition water-free .	....	.. ....	....	39.09	59.05	1.86

TABLE L.

COMPOSITION OF THE EDIBLE PORTION OF THE CARCASS.

STEER 3.

	WEIGHTS.		WEIGHTS OF CONSTITUENTS.			
	Fresh—pounds.	Water-free pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	107.7	32.6	75.10	21.20	10.39	1.01
Fat of fore quarter	31.7	25.1	6.60	2.50	22.49	.10
	139.4	57.7	81.70	23.70	32.88	1.11
Percentage composition fore quarter	....	....	% 58.61	% 17.00	% 23.59	% .80
Percentage composition water-free.	... .	....	....	41.08	56.99	1.93
Lean of hind quarter	110.0	31.9	lbs. 78.10	lbs. 22.04	lbs. 8.80	lbs. 1.07
Fat of hind quarter	39.5	32.8	6.70	1.78	30.92	.10
	149.5	64.7	84.80	23.82	39.72	1.17
Percentage composition hind quart'r	....	....	% 56.71	% 15.94	% 26.57	% .78
Percentage composition water-free.	....	....	....	36.82	61.38	1.80
Fore quarter	139.4	57.7	81.70	23.70	32.88	1.11
Hind quarter	149.5	64.7	84.80	23.82	39.72	1.17
	288.9	122.4	166.50	47.52	72.60	2.28
Percentage composition of side	....	....	% 57.63	% 16.45	% 25.13	% .79
Percentage composition water-free.	....	....	....	38.83	59.31	1.86

TABLE LI.

COMPOSITION OF THE EDIBLE PORTION OF THE CARCASS.

STEER 4.

	Weights.		Weights of Constituents.			
	Fresh—pounds.	Water-free—pounds.	Water—pounds.	Protein—pounds.	Fat—pounds.	Ash—pounds.
Lean of fore quarter	80.8	24.5	56.30	15.91	7.81	.78
Fat of fore quarter	14.4	11.8	2.60	.46	11.30	.04
	95.2	36.3	58.90	16.37	19.11	.82
Percentage composition fore quarter	....	... .	% 61.87	% 17.20	% 20.07	% .86
Percentage composition water-free	....	....	....	45.10	52.64	2.26
Lean of hind quarter	85.4	26.9	lbs. 58.50	lbs. 17.51	lbs. 8.53	lbs. .86
Fat of hind quarter	14.3	12.6	1.70	1.10	11.46	.03
	99.7	39.5	60.20	18.61	19.99	.89
Percentage composition hind quart'r	....	....	% 60.38	% 18.67	% 20.06	% .89
Percentage composition water-free	....	....	......	47.12	50.63	2.25
Fore quarter	95.2	36.3	lbs. 58.90	lbs. 16.37	lbs. 19.11	lbs. .82
Hind quarter	99.7	39.5	60.20	18.61	19.99	.89
	194.9	75.8	119.10	34.98	39.10	1.71
Percentage composition of side	....	....	% 61.12	% 17.94	% 20.06	% .88
Percentage composition water-free	....	....	....	46.15	51.59	2.26

TABLE LII.

PERCENTAGE COMPOSITION OF TOTAL DRESSED CARCASS.

		In Fresh Substance.				In Water-Free Substance.		
		Water—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.
Protein rich food	Steer 1, fed 17 months	59.02	17.89	18.53	4.56	43.66	45.23	11.11
	Steer 2, fed 27 months	51.91	16.93	25 86	5.30	35.20	53.78	11.02
Protein poor food	Steer 3, fed 27 months	52.16	17.10	25.32	5.42	35.75	52.90	11.35
	Steer 4, fed 17 months	56.30	17.82	20.27	5.61	40.77	46.39	12.84

TABLE LIII.

COMPOSITION OF EDIBLE PORTION OF DRESSED CARCASSES, EXCLUSIVE OF KIDNEY FAT.

	In Fresh Substance.				In Water-Free Substance.		
	Water—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.	Protein—per cent.	Fat—per cent.	Ash—per cent.
Fore quarter, steer 1	63.46	17.69	18.01	.84	48.41	49.28	2.31
2	59.21	15.90	24.10	.79	38.99	59.07	1.94
3	58.01	17.25	23.93	.81	41.08	56.99	1.93
4	61.87	17.20	20.07	.86	45.10	52.64	2.26
Hind quarter, steer 1	62.91	17.44	18.82	.83	47.02	50.75	2.23
2	56.24	17.15	25.85	.76	39.18	59.04	1.78
3	56.71	15.94	26.57	.78	36.82	61.38	1.80
4	60.38	18.67	20.06	.89	47.12	50.63	2.25
Total side, steer 1	63.18	17.56	18.44	.82	47.66	50.07	2.27
2	57.63	16.56	25.03	.78	39.09	59.05	1.86
3	57.34	16.56	25.30	.80	38.83	59.31	1.86
4	61.12	17.94	20.06	.88	46.15	51.59	2.26

TABLE LIV.

PROPORTIONS OF EDIBLE NUTRIENTS IN THE CARCASS.

	Refuse—%.	Edible portion—%.	EDIBLE PORTION.				
			Water—%.	Water—free—%.	NUTRIENTS.		
					Protein—%.	Fat—%.	Ash—%.
STEER 1.							
Total fore quarter	18.30	81.70	52.74	28.96	14.02	14.27	.67
Total hind quarter	13.07	86.93	53.85	33.08	13.26	19.19	.63
Total hind quarter without kidney fat	13.78	82.22	54.01	28.21	13.26	14.32	.63
Whole side	15.52	84.48	53.31	31.17	13.61	16.91	.65
Whole side without kidney fat	15.97	84.03	54.75	29.28	13.95	14.66	.67
STEER 2.							
Total fore quarter	16.83	83.17	50.20	32.97	12.85	19.48	.64
Total hind quarter	13.54	86.46	45.79	40.67	13.84	26.20	.63
Total hind quarter without kidney fat	14.38	85.62	46.06	39.56	15.50	23.36	.70
Whole side	15.09	84.91	47.87	37.04	13.37	23.04	.63
Whole side without kidney fat	15.57	84.43	49.31	35.12	13.73	20.74	.65
STEER 3.							
Total fore quarter	18.51	81.49	48.52	32.97	13.55	18.79	.63
Total hind quarter	13.90	86.10	47.60	38.50	12.34	25.56	.60
Total hind quarter without kidney fat	14.70	85.30	50.20	35.10	12.92	21.55	.63
Whole side	16.08	83.92	48.03	35.89	12.91	22.36	.62
Whole side without kidney fat	16.56	83.44	49.38	34.06	13.22	20.20	.64
STEER 4.							
Total fore quarter	17.54	82.46	52.99	29.47	13.29	15.51	.67
Total hind quarter	14.57	85.43	49.88	35.55	14.31	20.55	.69
Total hind quarter without kidney fat	15.46	84.54	52.65	31.89	15.02	16.15	.72
Whole side	16.00	84.00	51.39	32.61	13.82	18.11	.68
Whole side without kidney fat	16.49	83.51	52.83	30.68	14.16	15.83	.69

TABLE LV.

PROPORTIONS OF EDIBLE MATERIAL IN THE DRESSED CARCASSES OF THE FOUR STEERS.

	Total water-free edible material—per cent.	NUTRIENTS, PROPORTIONS OF EDIBLE.		
		Protein—per cent.	Fat—per cent.	Ash—per cent.
Whole side, without kidney fat, steer 1	29.28	13.95	14.66	.67
2	35.12	13.73	20.74	.65
3	34.06	13.22	20.20	.64
4	30.68	14.16	15.83	.69

The most important consideration in the experiment which we are now discussing is the relative influence of widely different rations upon the development and composition of the bodies of the experimental animals. We have seen that one pair of steers was fed a much larger amount of protein, both absolutely and relatively to the other food constituents, than the other pair.

Of the two steers killed at the end of seventeen months, Steer 1 ate 619 pounds of digestible protein and 3029 pounds of digestible carbohydrates and fats, while Steer 4 ate 370 pounds of digestible protein and 3418 pounds of digestible carbohydrates and fats.

In the case of the two steers killed at the end of twenty-seven months Steer 2 ate 1265 pounds of digestible protein and 6174 pounds of digestible carbohydrates and fats, and Steer 3 ate 700 pounds of digestible protein and 6422 pounds of digestible carbohydrates and fats. In other words, one pair of steers ate nearly eighty per cent. more protein than the other pair. Did this difference in the nutrition of the animals cause material variations in the general development of their bodies, in the proportionate weights of their parts or in the relative quantities of the four classes of constituents water, ash, protein and fat? We have seen that the protein-rich ration caused a more rapid growth of the steers while they were quite young. Did it cause a different growth?

In endeavoring to answer this question we must be controlled by the facts secured with reference to

(1) The relative weights of the organs and parts of the bodies.
(2) The percentage composition of the different organs and parts.
(3) The percentage composition of the body as a whole.
(4) The percentage composition of the carcass.

(5) The percentage composition of the edible portions of the carcass.

(6) The relative amounts of edible material.

It must be borne in mind in this discussion that Steer 1 must be compared with Steer 4, and Steer 2 with Steer 3.

(1) *The relative weights of organs and parts.* Reference to Table shows no marked differences in the relative weights of the different organs and parts.

The proportion of carcass weight, for instance, varies but little in the four animals, as is shown below.

	Steer 1—per cent.	Steer 2—per cent.	Steer 3—per cent.	Steer 4—per cent.
Carcass in per cent of live weight	57.7	57.0	57.2	59.0
Proportion of carcass in body minus the skin and contents of the stomach and intestines.	75.2	73.1	75.9	74.8

A glance at the weights of the different organs reveals no evidence that the larger protein supply caused a more vigorous development of any one of them, neither does it appear that the greater carbohydrate supply increased the quantities of intestinal or kidney fats.

(2) *Composition of the fresh organs and parts.* The figures of Tables XXXVIII to XLII show that the composition of the various organs and parts of the four steers' bodies was somewhat variable, but there are no differences in this respect which can logically be attributed to the food. The great variation in the water content in the heart is accounted for in part by the greater or less amounts of fat and other attachments which were ground up with that organ. In the case of the lungs there appears to be no reasonable explanation of the greatly different percentage composition. The figures hint at an error, but a careful examination of the original data does not reveal any.

(3) *Percentage composition of the entire bodies, exclusive of skin and contents of stomach and intestines.* In Tables XXXIX to XLII are calculated the total quantities of protein, fat and ash in the bodies of the several animals, the skin and contents of stomachs and intestines being ignored. Having these figures and knowing the weights of all the parts in the fresh condition, it is possible to compute the percentage composition of the bodies of the animals as they existed before being killed. This has been done and the results appear in Table XLIII. There certainly is a striking similarity in the composition of the bodies of the steers of the same age. It is very noticeable that the older steers contain a less proportion of water and protein and a larger proportion of fat, but when we compare Steer 1 with Steer 4, and Steer 2 with 3, the differences are not important, and

we fail to discover any indication that the unlike rations have caused unlike growth of tissues.

(4) *Percentage composition of the carcasses (dressed beef.)* The carcasses have the same similarity of composition that the entire bodies do. Comparing the dressed beef from the steers of the same age we find essentially the same proportions of water, ash, protein and fat.

We observe here as in the case of the entire bodies that the older and more mature and fatter animals furnish beef with a smaller proportion of water and protein and a larger proportion of fat than the younger animals do.

(5) *Composition of the edible portion of the carcasses.* This includes in these cases all of the carcass but the bones. Some other material is not edible, such as certain connective tissues (tendons, cartilage &c.) and which would find its way into the kitchen refuse. The bones were all the non-edible portion, however, which it was easy to separate, and the proportion of edible material is not greatly too large. We still fail to find that the unlike rations have caused essential variations in the proportion of water or of any class of constituents in the flesh of the animals. As noted with the dressed beef, the edible parts of the carcasses of the older and maturer steers contain smaller proportions of water and protein and larger proportions of fat than is the case with the younger animals. This fact, though not new, endorses the popular belief that "young" beef does not "spend" as well as that from maturer animals.

The writer is obliged to confess that he is surprised at the outcome of the investigation under discussion. He had expected that the ration with a liberal supply of protein would cause a more generous development and proportion of muscular tissue than the other ration generally regarded as somewhat deficient in protein, and that the latter ration would produce animals relatively richer in fat. This expectation is not realized. While the protein-rich ration did for a time cause more growth than the other, we are unable to discover that it was different growth.

The flesh of the animals which ate the ration relatively poor in protein did not differ in general appearance from that of the other animals, and a chemical analysis does not show any essential difference in the proportions of protein and fats.

This investigation adds materially to the facts previously known which go to show that the individual animal possesses a constitutional inertia which may not easily be overcome. It is, perhaps, only when we resort to extreme measures, that we are able to disturb the methods of growth to which the animal by breeding is committed. It appears that though the ration varies widely, an animal selects from it and assimilates, such materials as suit the needs and purposes of that particular organism, and that while the rate of production may be very much modified by the character of the ration, the kind of production, whether of meat or of milk, is chiefly controlled by the constitutional habit, unless as before stated the conditions of nutrition are rendered very abnormal.

These remarks are not offered as a new or final conclusion, but rather as indicating a general law which the feeder must, and already practically does, recognize.

It is interesting, at least, to note two other points concerning which the preceding data give definite information.

These points are:

(1) The proportion of the actual growth of the animal which may ordinarily serve as human food and therefore is most valuable.

It is easy to ascertain this proportion in the case of these four steers, and this is given in the table which follows:

TABLE LVI.

PROPORTIONS OF NON-EDIBLE MATERIAL IN ENTIRE BODIES OF STEERS.

	Dry Matter.	Protein.	Fat.	Ash.
STEER 1.				
In entire body, exclusive of skin, pounds	298.5	127.6	138.2	32.7
In edible portion, including kidney fat, pounds	171.1	74.7	92.8	3.6
In non-edible portion, pounds	127.4	52.9	45.4	29.1
Per cent in non-edible portion	42.7	41.5	32.8	89.0
STEER 2.				
In entire body, exclusive of skin, pounds	475.0	167.9	255.0	52.02
Edible portion, including kidney fat, pounds	273.0	98.6	169.7	4.7
In non-edible portion, pounds	202.0	69.3	85.3	47.3
Per cent in non-edible portion	42 5	41.3	33.4	90.9
STEER 3.				
In entire body, exclusive of skin, pounds	449.6	161.4	237.6	50.6
Edible portion, including kidney fat, pounds	265.6	95.5	165.5	4.6
In non-edible portion, pounds	184.0	65.9	72.1	46.0
Per cent in non-edible portion	40.9	40.8	30.3	90.9
STEER 4.				
In entire body, exclusive of skin, pounds	294.7	120.3	138.8	35.5
Edible portion, including kidney fat, pounds	166.0	70.3	92.2	3.4
In non-edible portion, pounds	128.7	50.0	46.6	32.1
Per cent in non-edible portion	43.7	41.6	33.6	90.4

It seems that without taking into consideration the skin and hair, over forty per cent. of the dry matter of the animal body is rejected as unfit for food, unless we allow for the use that is sometimes made of the heart, liver and portions of the large stomach.

If we include in the refuse (in the sense of use as food) the skin and the ordinary kitchen waste, we find that very nearly half of the dry matter in body of a fat steer is either wholly wasted or is used for less important and valuable purposes than serving as food for man.

This is in strong contrast to milk as an animal food product, none of which is necessarily rejected.

It has been stated that two of the steers were slaughtered and analyzed at the age of about twenty-two months, while the other pair was fed for ten months longer.

It appears from our analyses entirely probable that the four animals were practically alike in composition when of the same age. This being assumed, we are in a position to learn the composition of the growth during the last ten months of feeding of the older pair.

LVII.

COMPOSITION OF INCREASED GROWTH OF OLDER STEERS.

	IN FRESH MATERIAL.		IN WATER-FREE MATERIAL.		
	Water.	Dry substance.	Protein.	Fat.	Ash.
Entire bodies, except skin.					
Two steers fed 27 months	1,072.9	924.6	329.3	492.6	102.6
Two steers fed 17 months	829.2	593.2	248.0	276.9	68.2
	243.7	331.4	81.3	215.7	34.4
Per cent composition younger steers	58.2	41.8	41.8	46.7	11.5
Per cent composition increase for next 10 mos.	42.4	57.6	24.5	65.1	10.4

These results accord in a general way with those reached by Lawes & Gilbert. Those investigators found that the increase in fattening an animal contained a much smaller proportion of water and a greatly larger proportion of fat than the entire body.

The increase in the later stages of growth is of very much the same character, two-thirds of this consisting of fat, whereas the bodies of the younger steers were less than half fat.

SUMMARY.

(1) Beginning at the age of four to six months two pairs of steers were fed from seventeen to twenty-seven months on rations differing widely in their nutritive ratio, one ration having a ratio of 1:5.2

and the other, 1:9.7. One pair ate 1884 pounds of digestible protein in the same time the other pair ate 1070 pounds.

(2) One steer of each pair was slaughtered and analyzed at the end of seventeen months feeding, the remaining steers being fed for ten months longer, when they were killed and analyzed. The chemical analysis included the entire bodies, excepting the skin and the contents of the stomach and intestines.

(3) At the end of fifteen months feeding, the pair of steers fed on the ration richer in protein had gained 221 pounds of live weight more than the pair fed the ration less rich in protein. The later growth with two steers showed a difference in favor of the ration less rich in protein.

(4) The relative weights of organs and parts of the body was practically the same with the steers of the same age, independently of the ration.

(5) The kind of growth caused by the two rations, viz: the proportions of water, protein, fat and ash, was not materially different with the steers of the same size.

This is true whether we consider the entire bodies, the dressed carcasses or the edible portions of the carcasses.

With steers fed for the same time, the composition of the entire bodies, the proportion and composition of the carcasses, and the proportions and composition of the edible parts were practically alike.

(6) The older pair of steers, viz: those fed for ten months longer time, contained a smaller proportion of water and a larger proportion of fat than the younger animals.

(7) The older animals furnished five pounds per hundred more of water-free edible material than the younger animals. This is equivalent to a difference of twelve pounds of fresh, edible meat.

HORTICULTURAL DIVISION.

H. P. GOULD, Assistant Horticulturist.

The work of this department during the past year has,in a general way, been a continuation of the investigations of previous years. Cultural methods of certain vegetables have received attention, though the dry weather seriously affected all garden vegetables, and on this account no report can be given on many of the experiments planned at the beginning of the season. Especially does this apply to our work with tomatoes and cauliflowers.

The number of varieties of small fruits growing in the station gardens has been considerably increased and new varieties are constantly being added.

I—NOTES ON POTATOES.

FUNGIROID AS A PREVENTIVE OF POTATO ROT.

Almost every year brings to light new insecticides and fungicides; some of these discoveries are of great value, while many of them are no better and often far inferior to the older and better known materials.

Quite recently there has been put upon the market a fungicide known commercially as "fungiroid." This article is manufactured by Leggett & Brother, New York, and is said by them to be a powdered Bordeaux mixture and a substitute for that fungicide as ordinarily prepared. So far as I am aware, its qualities have not been thoroughly tested. If fungiroid should prove to be equally as effective as Bordeaux mixture, its advantage over the latter would be its ease of application. This applies especially in the treatment of low-growing plants.

It has been proven many times, beyond a doubt, that "potato rot" or "late blight" can be held in check, if not entirely prevented by the use of Bordeaux mixture. In order to test the efficacy of fungiroid as a means of combating this disease, a plat of potatoes was treated in the following manner: The first row was sprayed with Bordeaux mixture; fungiroid was applied to the second, while the third was left untreated to serve as a check on the fungicides and so on throughout the plat—every third row in order receiving the treatment described above, making six rows sprayed with Bordeaux mixture, six treated with fungiroid, and an equal number which received no treatment.

The first application of fungicides was made July 13; two other applications were subsequently made at intervals of about two weeks.

The following table gives a summary of each of the six rows:

BORDEAUX MIXTURE VS. FUNGIROID.

Treatment.	Total weight lbs.	Ratio of yield.	Weight of decayed tubers. lbs.	Per cent of decayed tubers.
Bordeaux	262¼	1.00	1.1	.4
Fungiroid	219	.83	18.7	8.5
Check	198¼	.75	20.8	10.2

Referring to the column, "ratio of yield," it will be observed that the total yield of the untreated rows was only seventy-five per cent. that of the rows sprayed with Bordeaux mixture, or an increase of twenty-five per cent. from the use of the Bordeaux; the total yield from the rows treated with fungiroid was eighty-three per cent. that of the rows sprayed with Bordeaux, or an increase of seventeen per cent. in favor of Bordeaux mixture over fungiroid.

The last column gives the per cent. of decayed tubers. The rows sprayed with Bordeaux mixture produced only .4 of one per cent. by weight of decayed tubers, while from the unsprayed rows over ten per cent. by weight of the tubers were decayed. The fungiroid seemed to have but little effect in preventing the decay.

The results do not promise the future for the fungiroid which had been hoped for it, yet we do not wish to draw final conclusions from this one season's trial.

Conclusion: Fungiroid may slightly increase the yield of potatoes but seems to be of very little value as a preventive of late blight.

II—NOTES ON SWEET CORN.

Every one who is at all familiar with the catalogue of the average seedsman is equally familiar with the high sounding and attractive description of varieties which most catalogues contain. We do not wish to infer that such descriptions are given for the purpose of deceiving, yet the fact remains that if one bases his anticipations on the descriptions which he finds, he is likely to be doomed to disappointment at the results which he obtains. While this condition of things does not exist in regard to the descriptions of corn to the extent that it does in regard to many other things, yet not a few of the statements are misleading. Especially have we found this to be true as to statements concerning the date of maturity. Very often varieties described as "early" have proven so late as to be almost worthless, and several so called medium sorts have failed to mature at all. A plausible excuse may appear, however, for this apparent deception when we consider the fact that practically all of the seeds disseminated by the larger seed companies are produced in a climate where the growing season is considerably longer than in Maine.

The following table represents most concisely the more important points relative to the varieties grown the past season:

Variety.	Source of seed.	Date of first appearance of tassels.	Date of first appearance of silks.	Date of edible maturity.	No. days from planting to date of maturity.	Average length of ears—inches.	Average height of stalks—feet.
Best of All	H. W. Buckbee	July 24	Aug. 1	Sept. 2	95	...	7.0
Cory (White)	J. M. Thorburn & Co	July 12	July 24	Aug. 17	79	6.0	4.5
Crosby's Early	J. M. Thorburn & Co	July 20	Aug. 5	Sept. 2	95	....	6.0
Early Dawn	Johnson & Stokes	July 24	Aug. 7	Sept. 7	100	7.5	6.5
Early Sweet	D. M. Ferry & Co	July 24	Aug. 7	Sept. 11	104	9.0	7.5
Early Sunrise	Iowa Seed Co.	July 12	July 26	Aug. 17	79	7.0	6.0
Early Vermont	A.W. Livingston's Sons,	July 12	July 26	Aug. 24	86	....	4.0
Eastman's Early	Eastman Seed Co	July 12	July 26	Aug. 17	79	....	4.0
Hance's Early	A.W. Livingston's Sons,	July 24	Aug. 10	Sept. 11	104	7.5	6.5
Henderson Sugar	Peter Henderson & Co.	July 24	Aug. 7	Sept. 7	100	9.0	8.0
Hickox Hybrid	D. M. Ferry & Co.	July 17	Aug. 7	Sept. 7	100	9.0	7.0
Honey	Johnson & Stokes	July 24	Aug. 10	Sept. 7	100	8.0	8.0
Lackey's Early Sweet	J. J. H. Gregory & Son	July 12	July 26	Aug. 17	79	6.0	5.0
Livingston's Evergr'n,	A.W. Livingston's Sons,	July 24	Aug. 10	Sept. 15	108	9.0	7.5
Melrose	J. M. Thorburn & Co	July 26	Aug. 7	Sept. 5	98	....	5.0
New England	D. M. Ferry & Co.	July 15	Aug. 1	Aug. 31	93	7.0	6.0
Perry's Hybrid	J. M. Thorburn & Co	July 20	Aug. 5	Sept. 7	100	8.0	6.5
Quincy Market	J. J. H. Gregory & Co	July 15	July 30	Aug. 26	88	...	5.0
Shaker's Early	A.W. Livingston's Sons,	July 24	Aug. 8	Sept. 11	104	8.0	6.5
Stabler's Early	J. J. H. Gregory & Son.	July 29	....	Sept. 11	104	8.0	7.5
XX Sugar	W. H. Maule	July 24	Aug. 7	Sept. 11	104	7.0	5.5
*Acme Evergreen	Iowa Seed Co.	July 29	Aug. 19	....	...	....	7.0
*Burlington Hybrid	A.W. Livingston's Sons,	July 29	Aug. 7	....	...	....	7.0
*Country Gentleman	Johnson & Stokes	July 30	Aug. 17	....	...	....	7.0
*Early Large 8-Rowed	A.W. Livingston's Sons,	July 27	Aug. 10	....	...	....	8.0

* Did not reach edible maturity.

The varieties named above were all planted the last of May. The first killing frost was about the middle of September, so that in addition to the varieties which failed to reach edible maturity those which matured on or after Sept. 11, of which there were several, were of but very little value for table use, as the date of edible maturity given in column five refers to the day on which the first ear was found which had reached an edible condition; this date, in most cases, was several days before enough ears could be picked to test the varieties.

For several years past the Cory has been the standard of earliness, but in quality it is far from perfection. As may be observed by referring to the table, several varieties were grown the past season which came to edible maturity on the same date as Cory—seventy-nine days from date of planting. The variety—Early Sunrise—seems worthy of special mention. The quality compares very favorably with that of most later varieties and it was the most prolific variety grown.

Of the varieties which failed to reach edible maturity, we would call attention to the Country Gentleman, from the fact that since its introduction several years ago, no variety has received more favorable comment than this one, but for this State it is of little value on account of its lateness. It may mature under the most favorable conditions although it has been grown here for the past three years and in no case has it reached an edible condition before frosts, when given ordinary field culture.

III—NOTES ON PEAS.

It is a well known fact that nearly all of the earliest varieties of peas are what are commonly known as "smooth" or "hard" peas; the poor quality of this type is equally well known. One of the aims of the introducer has been to secure a sort which should possess the qualities of the later or "wrinkled" varieties and at the same time be as early as the smooth varieties. Efforts in this direction have been at least partially rewarded with success. There have been put upon the market during the past few years several varieties of the wrinkled type which are of excellent quality and also very early.

Our usual rate of seeding has been one quart of seed to 100 feet of drill, though it is probable that one quart to 75 or 80 feet of drill may be a more profitable rate.

The following descriptions are of "wrinkled" varieties of recent introduction which can be recommended for general cultivation.

Station, (Gregory): Of moderately vigorous growth; 5 to 6 peas to the pod; quality good; maturing in from 45 to 55 days.

Morning Star, (Childs): Growth somewhat less vigorous than Station; 5 to 6 peas to the pod; quality excellent; reaches edible maturity in 45 to 55 days.

Exonian, (Thorburn & Co.): Vines medium height but very small; foliage noticeably light colored; about 6 peas to the pod; maturing in from 50 to 60 days.

Early Woodside, (H. N. Smith): Of rather drawf habit; 6 peas to the pod; quality good; from 60 to 70 days required to reach edible maturity.

Climax, (Northrup, Braslan & Goodwin Co.): A very tall variety with rather small vines; one of the most prolific; quality not of the best; matures in about 70 days.

Echo, (Burpee): A moderately vigorous grower; 7 peas to the pod; matures in from 65 to 75 days.

Renown, (Burpee): Of rather drawf habit; prolific; season medium to late.

Nott's Excelsior, (Maule): A dwarf sort about 1 foot in height; 5 or 6 peas to the pod; matures in 50 to 55 days. Has received many favorable comments during the past 4 or 5 years.

The above are only a few of the many sorts which might be mentioned in the connection of "new varieties" but to increase the list woud be doubtless to increase the indecision if one were selecting varieties for planting.

In our comparison of varieties such well known sorts as American Wonder, Heroine, Stratagem, Telephone, Abundance, and several others of like reputation have been taken as the standard of excellence.

Of the smooth peas, we will simply make mention of the following varieties: Maud S., Sunol, Summit, Rural New Yorker, Alaska, Daniel O'Rourke Improved. These varieties have no marked distinctive characteristics aside from the type and their chief value lies in the earliness of maturity.

It will be observed that in the foregoing descriptions considerable latitude is given for the time required by the different varieties to reach edible maturity. This wide variation is given from the fact the season has considerable influence upon the time required to reach edible maturity, the number of days being less in a warm than in a cold season. The same difference is noticeable in the time required for the maturity of early and late sowed peas of the same variety.

IV—NOTES ON CABBAGES.

The attention given to cabbages during the past season, as heretofore, was confined chiefly to the study of different methods of culture. Several questions regarding the subject, which have previously received little if any attention, have been investigated.

The seed was all sown April 1st in the forcing house, and the plantlets pricked out into seed flats April 27th where they were allowed to remain until May 25th, when they were all set in the field.

The season was exceptionally dry and although the plants did not suffer from lack of moisture sufficiently to cause them to wilt yet they made a less vigorous growth and consequently smaller heads than would have been the case if there had been more rain.

1. INFLUENCE OF SIZE OF SEED. It has been thought by some that the amount of leaf surface relative to the size of the head, is influenced by the size of the seed, the supposition being that plants from large seeds run to leaf at the expense of the head, while with plants from small seed the tendency is the opposite.

That we might assertain, if possible, the accuracy of this view, three varieties of seed were chosen, from each variety of which were selected fifty of the largest seeds, also fifty of the smallest. The seeds were all sowed and when the plantlets were ready for the first handling, twenty of the best specimens from each lot were pricked out into seed flats and then treated as already described.

The comparative results are given in Table I.

TABLE I.

INFLUENCE OF SIZE OF SEED.

Variety.	Weight of 50 seeds—grams.	Heaviest head—pounds.	Lightest head—pounds.	Average weight—pounds.	Per cent of heads cracked.	Per cent of heads immature.	Per cent of plants not forming heads.	Ratio.
Harvest Home:								
Large seed....	.339	9.1	2.1	6.1	7.7	15.4	23.1	.94
Small seed..... ...	.180	8.1	2.3	6.5	.0	.0	.0	1.00
Reynolds' Early:								
Large seed..........	.370	9.7	2.6	5.9	11.8	.0	5.9	1.37
Small seed..........	.169	6.9	2.1	4.3	9.1	18.2	27.3	1.00
Ballhead:								
Large seed..........	.319	8.5	3.6	5.9	.0	.0	.0	1.69
Small seed.........	.140	7.1	2.6	3.5	.0	.0	.0	1.00

The first column of figures gives the weight in grams of the various lots of seed. It will be observed that of the first variety, Harvest Home, the large seed weighed somewhat less than double that of the small seed while of the two other varieties, the large seed weighed more than twice as much as the small. The heaviest heads were produced by plants coming from the large seed while one of the smallest head was also produced by the large seed. In the case of the two last varieties referred to in the table, the smallest heads in comparison were from small seed. The figures relating to the maturity of the heads are so contradictory that no conclusions can be drawn regarding that point. The facts presented in the last column are perhaps the most striking and at the same time of the most value. These figures represent the ratio of the average weights of the heads compared. Representing the average weights of the heads from the small seed by 1, we find in case of the first variety that the average weight of the heads from the large seed is represented by .94. In other words, the large seed produced heads which averaged six per cent. less by weight than did those from the small seed. The average weights of the two other varieties, Reynolds Early and Ballhead, were 37 per cent. and 69 per cent. respectively in favor of the heads from large seed.

Deduction. It seems probable that the size of the seed has some influence upon the size of the head, the larger seeds as a rule, producing the larger heads.

2. Results of tying up the outer leaves. The idea has been entertained, that by binding the outer leaves together over the head

of the plant, maturity could be hastened. With this object in view, three lots of plants were treated accordingly as soon as the heads had commenced to form and corresponding lots were grown as checks.

The results, so far as represented by figures, are tabulated below.

TABLE II.

EFFECT OF BINDING OUTER LEAVES TOGETHER.

VARIETY.	Heaviest head—pounds.	Lightest head—pounds.	Average weight—pounds.	Per cent of heads cracked.	Per cent of heads immature.	Per cent of plants not forming heads.	Ratio.
Harvest Home.							
Outer leaves tied up	6.1	.8	3.0	26.7	.0	33.3	.44
Check	9.8	3.1	6.8	25.0	5.0	.0	1.00
Surehead.							
Outer leaves tied up	4.1	.8	2.6	14.3	.0	35.8	.46
Check	8.1	1.0	5.7	5.3	.0	5.3	1.00
Reynolds Early.							
Outer leaves tied up	4.9	.6	3.1	30.8	.0	53.8	.67
Check	9.9	2.1	4.6	47.1	5.9	17.6	1.00

The figures relative to the point in question reveal nothing from which we can infer that the operation has any influence upon the maturity of the heads.

By examining the table, however, it can readily be seen that the operation was not without its effects.

In next to the last column is found the percentage of plants from each lot which failed to form heads. Of the first variety, every check plant developed a head, while of the treated plants one-third failed to head; of the second variety, nearly the same proportion failed; while of the third variety, over one-half of the treated plants gave similar results, as did also about 17 per cent. of the check plants, making nearly the same difference between the percentage of plants failing to head in each comparison.

Again, the size of the head was greatly decreased by the treatment. The last column gives the relative weights of average heads. In two instances the average weight of the treated plants was less than one-half and in one case but little more than one-half that of the heads from the untreated plants.

Another result of tying up the outer leaves, which was even more noticeable than any yet mentioned, as the plants were growing in the field, was the effect upon quality. The overlapping leaves did not effectually shut out the rain, yet when the moisture had once entered the spaces between the leaves, it was sufficiently inclosed to prevent a rapid evaporation. This continued dampness among the leaves very soon caused the outer portions of the heads to decay. As the season advanced, the decay extended both outward and inward, resulting in a large proportion of the leaves falling off a long time before the growth of the plants would otherwise have ceased. The result was that not a single marketable head was produced by the plants receiving the special treatment. Doubtless the premature falling of the leaves accounts in a measure at least for the decreased size of the heads.

Deduction. Tying up the outer leaves of the cabbage appears to have no influence upon the maturity of the heads, but it results in a marked decrease in the size of the heads and causes them to decay.

3. EFFECT OF MULCHING: The value of straw or some similar material used as a mulch, in the conservation of soil moisture has often been discussed. Our experience in mulching tomatoes has already been reported.*

In order to ascertain, if possible, the effect of a similar treatment upon cabbages, several plants of three different varieties were given a mulch of swale hay, a sufficient amount being put on so that when packed down it should be two or three inches thick. It was applied after the plants had recovered from the check of being set in the field and growth had fairly begun. Three corresponding lots received frequent cultivation.

Table III is a statement of the results as represented by figures.

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* Report Maine Experiment Station, 1894, p. 64.

TABLE III.

EFFECT OF MULCHING.

Variety and Treatment.	Heaviest head—pounds.	Lightest head—pounds.	Average weight—pounds.	Per cent of heads cracked.	Per cent of heads immature.	per cent of plants not forming heads.	Ratio.
Lupton:							
Mulched	9.5	2.8	6.0	5.3	.0	.0	1.00
Cultivated	8.9	1.5	6.0	31.3	12.5	6 2	1.00
Surehead:							
Mulched	9.1	2.6	6.1	5.9	11.8	.0	1.07
Cultivated	8.1	1.0	5.7	5.3	.0	5.3	1.00
Harvest Home:							
Mulched	11.2	3.6	7.7	21.1	15.8	.0	1.13
Cultivated	9·8	3.1	6.8	25.0	5.0	.0	1.00

The facts expressed in the above table are not at all conclusive. By referring to the figures relative to the maturity of the heads, it will be observed that of the first variety about five per cent of the mulched and thirty-one per cent. of the heads from the cultivated plants were cracked at the time of cutting. As the cracking occurs as a result of over maturity, the comparison last made,would of itself seem to indicate that the difference in results was due to the different treatment, but when studied in connection with other facts it loses its significance. This is shown in the case of the second variety which gave nearly the same percentage of cracked heads in both lots of plants. The difference between the two lots of the third variety was not great—less than three per cent. The sixth column gives the percentages of immature heads at the time of cutting. Of the first variety, all of the heads from the mulched plants were fully mature while about twelve per cent. of the cultivated were immature; in the second case, the conditions are just reversed; in the third case, the difference was nearly the same as in the former, but five per cent. of the heads from the cultivated plants were immature. Comparing the observations in the three instances, we find the greater number of immature heads were obtained from the mulched plants, while all of the plants which failed to head were from the cultivated lots.

The most uniform difference between the results of the two methods of culture was in the size of the heads. This difference was not striking, however, and may have been the result of other causes, though the conditions were as nearly uniform as possible aside from the special treatment given. The average weights of the Lupton from both lots was the same; while of the Surehead and Harvest Home, the average weights were seven per cent. and thirteen per cent. respective greater from the mulched plants.

Deduction: Indications point to an advantageous use of a mulch in growing cabbages especially in a dry season.

4. SHALLOW CULTIVATION VS. DEEP CULTIVATION: The value of thorough cultivation has in recent years been greatly emphasized, though not unduly so, but as to just what is implied by thorough cultivation there may be a difference of opinion.

It has been our practice to use the cultivator with much freedom in the cultivation of nearly all garden vegetables and where the plants are set out carefully in straight rows the cultivator is usually run as close to the plants as possible without disturbing them. This becomes in many cases a method of root pruning. In order to determine, if possible, whether this method of cultivation has any specific effect upon the results obtained, twenty plants from each of four varieties were given the cultivation described above while four similar lots were given only such cultivation as could be furnished with a common hoe, though with the same frequency as the plants receiving deep cultivation.

The results are given in table IV.

TABLE IV.

SHALLOW VS. DEEP CULTIVATION.

VARIETY AND TREATMENT.	Heaviest head—pounds.	Lightest head—pounds.	Average weight—pounds.	Per cent of heads cracked.	Per cent of heads immature.	Per cent of plants not forming heads.	Ratio.
Harvest Home.							
Shallow cultivation	6.4	0.9	4.9	.0	52.6	5.3	.72
Deep cultivation	9.8	3.1	6.8	25.0	5.0	.0	1.00
Lupton.							
Shallow cultivation	7.9	1.6	5.6	15.8	5.3	5.3	.93
Deep cultivation	8.9	1.5	6.0	31.2	12.5	6.2	1.00
One-hundred Weight.							
Shallow cultivation	8.1	1.3	5.4	5.6	11.1	.0	1.12
Deep cultivation	6.8	3.2	4.8	.0	.0	16.7	1.00
Surehead.							
Shallow cultivation	10.0	3.0	6.6	5.3	10.5	.0	1.16
Deep cultivation	8.1	1.0	5.7	5.3	.0	5.3	1.00

Referring to the figures relating to the maturity of the different lots, it will be observed that of the first two varieties, the percentage of the cracked heads from the plants receiving deep cultivation was noticeably large, giving evidence of a greater maturity of the deeply cultivated plants; on the other hand the evidence of the third variety is contradictory and of the fourth, neutral. The difference in the percentages of immature heads gives evidence of the same fact; in three instances the proportion of immature heads was greater from the plants given shallow cultivation.

The effect of the different methods of culture did not seem to manifest itself in the size of the heads, as in two cases the results favor deep cultivation, while in the other two the larger heads were produced by the plants receiving shallow cultivation.

Deduction: Deep cultivation appears to hasten the maturity of the plants as evinced by the greater percentage of cracked heads from the deeply cultivated plants and by the greater percentage of immature heads from the plants given shallow cultivation. The size of the heads does not appear to be influenced by the different methods of culture.

VARIETIES.

Harvest Home: (Northrup, Braslan, Goodwin Co.) This is a late variety of good size, heads fairly solid, nearly spherical in shape.

Ballhead: (*Improved Danish Ballhead Winter*, James Vick's Sons). A rather small variety, shape nearly spherical, very hard and solid. Medium early.

Reynolds' Early: (Gregory). A medium early variety of good size, moderately firm and vigorous. Said to be the result of an artificial cross between the Scheweinfurt Quintal and Cannon Ball cabbage. This is a desirable variety for its season.

Lupton: (Maule). A sport form Excelsior Flat Dutch found in the fall of 1888. It forms a large, solid, flat head; plant strong and vigorous with a short stem. A very satisfactory variety for late use.

The other varieties mentioned above are satisfactory sorts but have no distinctive characteristics and require no special mention.

RECAPITULATION.

1. The size of the seed seems to have some influence upon the size of the head; the larger seed, as a rule, producing the larger head.
2. The tying up of the outer leaves appears to have no influence upon the maturity of the head, while it produces a marked decrease in the size and almost invariably causes the head to decay.
3. Mulching with straw or some similar material in a dry season tends to increase the size of the head.
4. Deep cultivation seems to have little if any effect upon the size of the head, but plants so treated appear to mature earlier and more uniformly than plants receiving shallow cultivation.

REPORT OF BOTANIST AND ENTOMOLOGIST.

Prof. F. L. Harvey.

Professor W. H. Jordan:

Dear Sir:—I have the honor to submit herewith my eighth annual report as botanist and entomologist for the experiment station.

The work of the season has been along the usual lines, embracing field work upon injurious plants and insects, laboratory investigations upon the life histories of insects and plants, preparation of material to illustrate lectures upon insects and weeds, lectures, preparation of articles for the press, correspondence and preparation of this annual report.

The most important field and laboratory work was upon the life history of *Trypeta* (*Epochra*) *Canadensis* (*Loew*) a fly doing much damage by stinging currants. This consumed considerable time during the summer months and the results of the study are given in the body of the report.

Boxes for storing specimens showing stages in the life history of a single insect, or small group of insects, have been made and the work of collecting and preparing specimens is in progress. These will be useful for comparison in study and determination of species and to illustrate talks upon insects before winter course students and farmers meetings.

A complete collection of weeds and forage plants is in process of preparation and will be useful for naming specimens sent for determination and to illustrate lectures.

Besides the local lectures to winter students in agriculture upon injurious insects and fungi, several appointments to lecture have been filled in various parts of the State; two for the Pomological Society at Presque Isle. two for the Board of Agriculture at West Rockport and Washington in Knox county, three at North Berwick, Saco and Cornish in York county; one at Turner Centre in Androscoggin county and one at North Jay, Franklin county, and two for granges at Fryeburg Centre and Monmouth. The subjects treated were Native Cranberries, Orchard and Farm Insects, Fungi and Weeds. At most points two subjects were considered.

An article upon Cattle Lice was written for the Lewiston Journal besides articles for other State papers, and also several papers of a technical nature upon the plants and animals of Maine were contributed to natural history journals.

As you are to sever your connection with the Maine Experiment Station at the close of the year I wish to thank you for the interest you have always taken in my work and for the liberal provision which has always been made to aid me in my investigatons and to express my regret thet such pleasant personal relations cannot continue.

DIRECTIONS FOR SENDING SPECIMENS

will be found in the annual report of the Experiment Station, 1888, page 194 or in the Maine Agricultural Report 1888, page 158.

CORRESPONDENCE.

It is the duty of the Station Botanist and Entomologist to answer questions regarding plants and insects that are of economic importance. Any citizen of Maine may avail himself of this privilege. Correspondence is therefore invited. We would particularly like to have farmers send us specimens of weeds they find in their fields as we wish to study the distribution of weeds in the State.

Below will be found notes upon the plants, and insects of importance that have claimed attention during the year. Those requiring detailed consideration are treated in the body of the Report. The usual tables of record of plants and insects are given below.

NOTES ON PLANTS.

BERTEROA INCANA, a cruciferous weed mentioned in our last report seems to have established itself, as specimens were received again this season. The various species of the mustard family are abundant in Maine.

THE DICHOTOMOUS CATCHFLY, which was received from so many sources last year was not reported this season. Being an annual and such a coarse conspicuous plant the farmers probably cut it before seeding, and will have no further trouble with it.

THE COMMON ST. JOHN'S WORT, was received from South Rumford. This species is common in Maine, and is a pernicious weed. A perennial with a tough root. It is common in pastures, roadsides and thickets.

THE WILD CARROT was found to be quite abundant in Knox county where it has become well established along neglected roadsides.

THE COMMON EVENING PRIMROSE is quite abundant in various parts of Maine. It was considered in Board of Agricultural Crop Bulletin for August, 1895. Its large yellow flowers built on the plan of four and its size make it a conspicuous weed. It is not so common as the sundrops mentioned in our last report.

THE YELLOW BED STRAW was received for the first time the past season. It occurs as a weed in fields in Carroll.

The Canadian Golden-rod is a common coarse species very abundant in fence corners and about pastures and thickets. It is usually associated with two or three golden-rods, asters and compositae.

The Cone Flower or Yellow Daisy as it is called in Maine is distributed throughout the State. It was introduced with grass and clover seed from the West.

The Scabrous Hawkweed a native species was received from several parties. It is related to the Orange Hawkweed, but is not nearly so bad a weed. The native species is found in open woods, thickets and grass lands. It has yellow blossoms and a leafy stem. The Orange Hawkweed has dark orange flowers.

The Giant Laural (*Rhododendron Maximum, L.,*) was received from Mr. C. S. Phinney of Standish. This is a rare species and the letter regarding it printed in the body of the report will be interesting.

The Clover Dodder reported last season, seems to be abundant having been received this season from Kennebec, Penobscot and Piscataquis counties.

The Creeping Thyme was reported for the first time. It is a weed belonging to the mint family.

The English Plantain is still being shipped into the State in clover seed. It was found in two samples of seed examined the past season.

The Black Bindweed, a common twining plant belonging to the same family as the smartweeds, docks, sorrels and buckwheat, was received from Piscataquis county. It is a plant introduced from Europe, and the seed abundant in western oats.

Bastard Toad Flax was reported from Sanford. It is not common in Maine. We have not seen it in Eastern Maine.

There has been no great damage done by fungi in the State the past season. The **Apple Scab** was more or less prevalent as usual. Not a single letter was received about other fungi. The dryness of the season would no doubt account for it.

NOTES ON INSECTS.

The Long-nosed Ox Louse was reported as very abundant on cattle in the vicinity of Thomaston, and from specimens sent by Mr. A. W. Batchelder, we were able to describe and figure the egg of this species which was not known before. This species is rare, the species found on cattle being more commonly the short-nosed louse, or sometimes the biting louse of cattle. An article upon cattle lice written for the *Lewiston Journal* is found in the body of the report.

The Woolly-Louse of the Apple was reported as feeding upon raspberries.

THE CHINCH BUG was found last August in a pasture in Moose River township about a mile from Jackman. The location was a sandy hillside. Quite large sports were infested. This species has been reported from Bethel about twenty-five miles north of Fryeburg. The new locality is fully 100 miles to the northeast.

THE YELLOW WOOLLY BEAR was reported as feeding upon raspberries. It has not been reported to the station before and therefore will be considered in this report.

THE APPLE-TREE TENT CATERPILLAR was received. This common insect should give no trouble as it is so easy to remove the egg clusters from the branches during the winter when the trees are leafless.

THE CLOTHES MOTH, (*Tinea Pellionella, L.,*) was found eating holes in carpets and shawls at Augusta.

THE MOURNING CLOAK BUTTERFLY did considerable damage to the foliage of elm trees about Waterville the past season.

THE CURRANT FLY, (*Trypeta* (*Epochra*) *Canadensis*) is doing considerable damage to currants in Maine. The fly stings the fruit and deposits an egg. The habits are much like those of the apple trypeta. This speces is considered, and illustrated in the body of the report.

Paoria Gilvipes, a small black beetle appearing the last of April or early in May, was reported as doing great damage by eating the buds on raspberry canes. Attention was called to this fact through the public print. In the body of the report the life history is given. This beetle is capable of doing much damage and has been a great nuisance to strawberry growers.

THE CUCUMBER FLEA BEETLE was reported as eating holes in petunia leaves. This is a common insect in early gardens feeding upon the leaves of radishes, cucumbers, squashes and potatoes. It is a small black beetle that has the power of jumping. There is a species of spring tail (*Smynthurus*) very common in Maine that has about the same habits as this beetle, and is liable to be mistaken for it. It is about the same size, jumps and eats small holes in the leaves. It should be called a garden flea, and may be distinguished by having long antennae and a forked jumping organ. It has never been described in the books.

THE LARDER OR BACON BEETLE is very abundant in Maine. The disgusting hairy larvae are well known to most house keepers. The insect is considered in the body of the report.

THE PEAR TREE SLUG continues to do some damage to the foliage of plum, pear and cherry trees. This insect was considered and figured in Station Report 1888, page 176.

THE GALL FLY (*Rhodites sp.*) In 1891 we found quite a number of moss like galls upon roses in the garden of Eben Webster, Orono, and reared from them the flies. Some of these were sent to Prof. Riley, who made the following reply:

"Your No. 3, is something of a puzzle. The gall is like that of the ordinary *Rhodites rosae*, but insect differs in the very important respect of totally lacking the parasidal sutures, a character which is at least of specific importance." We do not know whether the species was afterwards considered by Prof. Riley, nor what was done with the specimens. We did not study the insect further, and have not noticed the galls so abundant since. It is interesting to have the same galls reported from another locality, Mattawamkeag, Maine.

The black oak trees in Maine are often infested by a gall fly which produces large knotty excrescences on the branches, which are full of small holes after the insects have emerged. We have examined galls sent by Mr. Stover of Blue Hill, and find the species producing them is called by entomologists, *Callirhytis punctatus*, Bass.

THE HORN-TAILED BORER, a large species of saw fly that makes round holes about the size of a lead pencil in various trees was reported as laying its eggs in a maple tree.

THE APPLE MAGGOT, (*Trypeta Pomonella*) continues to be a great pest. It is spreading. Several parties have reported that by keeping the windfalls picked up or by keeping sheep in the orchard they have held it in check. As long as early apples are imported from Massachusetts, more or less infested with the larvae of this pest, our Maine towns will continue to be centres for the distribution of Trypeta.

THE BUFFALO CARPET BEETLE seems to be spreading, having been reported as very abundant in Saco, South Litchfield and Bangor.

PLANTS EXAMINED IN 1895.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1		*Berteroa incana*, D. C		Growing in grass lands. Introduced in 1893. Bad cruciferous weed.
2	Dichotomous Catchfly	*Silene dichotoma*, Ehrb.		
3	Long-leaved Chickweed	*Stellaria longifolia*, *Muhl.*	D. W. Lundray, Carroll	Growing in low grassy places.
4	Common St. John's-wort	*Hypericum perforatum*, L	T. H. Thornton, South Rumford	"A pernicious weed difficult to extirpate."
5	Lucerne. Alfalfa	*Medicago sativa*, L	E. P. Mayo, Waterville	Cultivated for fodder but spontaneous in fields. The specimens from Vassalboro.
6	Vetch	*Vicia Cracca*, L	G. G. Glover, Naples	Weed in mowing fields Bridgton. Native species but also found in Europe.
7	Cinquefoil	*Potentilla Norvegica*, L		Considered in August Crop Bulletin.
8	Common Evening Primrose	*Œnothera biennis*, L	T. H. Thornton, South Rumford	The plants sent by Mr. Thornton were considered in August Crop Bulletin. A coarse biennial weed with large yellow flowers.
9	Wild Carrot	*Daucus carota*, L	E. E. Light, Union	Very abundant in Knox county about Union and Washington.
10	Yellow Bed Straw	*Galium verum*, L	D. W. Lundray, Carroll	Weed in fields. Introduced from Europe.
11	Canadian Golden-rod	*Solidago Canadensis*, L	T. H. Thornton, South Rumford	Weed along the border of fields and thickets. A native species.
12	Common Fleabane	*Erigeron Philadelphicus*, L.	T. H. Thornton, South Rumford	A common native weed. Perennial. Cultivation needed to eradicate it.
13	Called Yellow Daisy in Maine Cone Flower. Nigger-head elsewhere	*Rudbeckia hirta*, L	T. H. Thornton, South Rumford E. B. Haynes, Monson	A western species. Introduced in grass and clover seed from the West. Not abundant nor especially dangerous.
14	Scabrous Hawkweed	*Hieracium scabrum*, Mx	Several parties	A native species in open woods and pastures. Has yellow flowers. Not dangerous.

15	Great Laurel	*Rhododendron maximum*, L	C. S. Phinney, Standish	Sent to be named. Rare in Maine. See letter in body of Report.
16	Clover Dodder	*Cuscuta Epithymum*, Murr	F. H. Parlin, East Winthrop I. N. Lapham, Pittston E. G. Lovejoy, Medford Center	A parasite upon red clover known by the fine yellow threads and clustered white flowers. Introduced from Europe.
17	Creeping Thyme	*Thymus serpyllum*, L	I. T. Merrill, China	A single bunch found on the farm. Not noticed before.
18	Ribgrass. English Plantain.	*Plantago lanceolata*, L	J. H. Barton, West Windsor H. A. Sprague, Charlotte	Plant growing in fields. In sample of clover seed inspected.
19	Water Smartweed	*Polygonum amphibium*, L	Abner T. Wing, Weld	Growing in bog hole from which muck had been taken.
20	Black Bindweed	*Polygonum Convolvulus*, L	E. G. Lovejoy, Medford Center	Weed in fields.
21	Bastard Toad-flax	*Comandra Umbellata*, Nutt	O. H. Perkins, Sanford	Weed in field. Not common. Root parasitic on roots of trees.
22	Reed Canary Grass	*Phalaris arundinacea*, L	D. W. Lundray, Carroll	Weed in fields. Native species which also grows in Europe.

INSECTS EXAMINED IN 1895.

No.	COMMON NAME.	TECHNICAL NAME.	FROM WHOM RECEIVED.	REMARKS.
1	LONG-NOSED OX LOUSE	*Hæmatopinus vitula*, L.	A. W. Batchelder, Thomaston	Very abundant on cattle.
2	WOOLLY LOUSE OF THE APPLE,	*Schizoneura lonigera* (Hausm.)	Dr. A. I. Harvey, Newport	Feeding on raspberry plants. (See Station Report 1890, p. 131.)
3	THE CHINCH BUG	*Blissus leucopterus*, Say	F. L. Harvey, Orono	Found in pastures near Jackman, Me., in August.
4	THE YELLOW WOOLLY BEAR	*Spilosoma Virginica* (Fabr.)	M. B. Whiting	Feeding on raspberry leaves.
5	THE APPLE-TREE TENT CATERPILLAR	*Clissiocampa Americana* (Harris)	E. G. Lovejoy, Medford Center.	Feeding on apple trees.
6	THE APPLELEAF BUCCULATRIX,	*Bucculatrix pomifoliella* (Clem.).	L. F. Abbott, Lewiston	Feeding on apple leaves in the vicinity of Wilton. (See Ex. Sta. Report 1893, p. 164.)
7	CLOTHES MOTH	*Tinea tapetzella*, L.	Mrs. Andrews, Augusta	Found eating holes in a shawl and carpet.
8	MOURNING CLOAK BUTTERFLY,	*Euvanessa antiopa*, L.	E. P. Mayo, Waterville	Feeding on elms. (See Ex. Sta. Report 1888, p. 187.)
9	THE CURRANT FLY	*Epochra Canadensis* (Loew.)	F. L. Harvey, Orono	Doing much damage to currants in Maine by stinging the fruit.
10	THE SPOTTED PARIA	*Paria gilvipes* (Def.)=*Typophorus canellus gilvipes* (Def.)	W. C. Symonds, North Norway C. L. Bray, Hebron	Attacking the buds on raspberry canes. Appearing the last of April or early in May.
11	THE CUCUMBER FLEA-BEETLE	*Crepidodera cucumeris* (Harris)	W. L. Mower, Greene	Attacking petunia leaves. Common in spring on cucumbers, radishes, potatoes, &c.
12	LARDER OR BACON BEETLE	*Dermestis lardarius*, L.	Mrs. Albert Caswell, New Sharon	Found about rennet, old cheese and in bread closet.
13	THE PEAR-TREE SLUG	*Selandria cerasi* (Peck)	C. L. Duncan, Wells W. L. Mace, East Winthrop	Attacking leaves of plum, pear and cherry trees. (See Station Report 1888, p. 176.)
14	ROSE GALL FLY	*Rhodites sp.* (probably new)	Stark Webster, Mattawamkeag,	Producing large mossy galls upon roses.
15	OAK TREE GALL.	*Callirhytis punctatus* (Bass.)	Austin Stover, Bluehill	Producing galls on oak trees.
16	THE HORN-TAIL BORER	*Tremex columba*, L.	Geo. P. Billings, Clinton	Depositing eggs in maple trees in which the larva live.

BOTANY.

SECOND BLOOMING OF PEAR TREES.

I have received from Hon. Samuel Libby of Orono, specimens of pear tree twigs in full bloom, taken from a pear tree in the orchard of R. H. Libby of Newport. We have also received recently from Aroostook county specimens of cherry twigs bearing bloom. The following facts regarding unusual and second blooming may be worthy of record.

It is a principle well known to botanists that the last effort of a plant is to reproduce itself. When a tree puts forth unusual bloom, or bloom out of season, it may be reasonably inferred that something is disturbing its normal functions or sapping its vitality. There are several causes, external and internal, that may produce this result.

(a) If a tree puts forth unusual bloom beyond what is normal and the tree shows no other signs of injury, it would be well to look for borers in the trunk or insects that feed on the roots.

(b) Fungi that attack the foliage, or injurious insects that feed upon the leaves may so check the growth of the annual shoots that the effort to reproduce will show itself the same season in late blooming.

This is the case with the pear tree in Mr. Libby's orchard. The blades of the leaves upon the twigs shown us, were almost entirely eaten by some unknown insect, the petioles and midribs only being left. The new shoots and flower buds were formed before the insect began its attack. The leaves were almost entirely eaten, the vitality of the tree checked, and the effort to reproduce caused the tree to put forth full bloom. The insect had done its work and gone into the ground to transform when attention was called to the tree by the late bloom.

Of course a tree suffers from such a shock and the bloom for the following season is destroyed, and without leaves the plant cannot elaborate food for present or future use and is quite liable to die. A few twigs may be affected by insects or fungi and the general vitality not impaired.

(c) Sometimes when growth is checked early in the season by drought and followed by a wet fall, plants take on a second or fall growth. They put forth the flowers in the fall that normally would not develop until the next season. Of course the following season would be a shy bearing year. Fall and spring growth is shown in the trunks of exogenous trees by two narrow rings which together about equal those of ordinary years.

Advantage is taken of the tendency of plants to reproduce when their vitality is checked to bring trees into early blooming. By putting a stone in the crotch, or binding a limb with a cord, or even girdling a twig or trunk the vitality is checked and the tree brought into early bearing.

CATTLE LICE.

During the long Maine winters when snow on the ground prevents animals from finding dry earth to paw over themselves, they are apt to become lousy. Cattle lice breed rapidly. A single infested animal, if neglected, will before spring become literally alive, and by close contact in the stable and yard is almost certain to spread the parasites to the whole herd. These parasites are therefore more apt to give trouble during the winter. We have recently received specimens for examination, accompanied by a request for information as to the nature of the parasites, and how to destroy them. As there seems to be a demand for information we can better serve the many by preparing an article on these pests. The following article is designed to give information regarding lice in general, and to consider more in detail, three species that infest domestic cattle. Those wishing information regarding lice that affect other domestic animals will do well to procure a copy of Bulletin No. 7, Division of Entomology U. S. Department of Agriculture, from which the cuts to illustrate this article were taken.

GENERAL CONSIDERATION.

The term louse is derived from the same root as loss and loose, and is used in the sence of damager or destroyer and applies to quite a variety of degraded crustacean and insect parasites that do more or less damage to their hosts.

All of the lice belong to that branch of the animal kingdom called *Arthropoda* (jointed-footed animals) which embraces the crustaceans and insects. To the crustaceans belong the wood lice or sow bugs, non-parasitic, and feeding upon decaying organic matter and found in damp places. Some of their near relatives are true fish parasites and together with a large number of other degraded crustaceans, parasitic on fish, sea mammals and other crustaceans, are called fish lice. Certain mites (degraded spiders) are often called lice. To this group belong the red lice or harvest ticks, and the well-known itch louse or itch mite and others. These have eight legs.

The remainder of the lice are true insects (*Hexapods*) having six legs and belonging to several orders. Insects themselves are infested with minute lice. Those known as bee lice are degraded flies (*Diptera.*)Bees are also infested by minute lice belonging to the order *Coleoptera* (beetles.)

The bark lice, plant lice, and jumping plant lice are bugs (*Hemiptera.*)They are provided with beaks by means of which they suck the juices of plants. The sucking lice of animals, embracing the head louse and body louse of man and a large number of other species parasitic upon domestic and wild animals, are also bugs and belong to the order *Hemiptera* (half-winged insects.)

The bird lice or biting lice include a large number of species of wingless parasites that infest birds and animals, and belong to the order *Pseudoneuroptera* (false nerve-winged insects.)

With the above general consideration we proceed to consider the lice of domestic cattle, two species of which belong to the sucking lice and a third belonging to the bird or biting lice.

SHORT-NOSED OX-LOUSE.

(*Haematopinus Eurysternus, Nitzsch.*)

ORDER HEMIPTRA; FAMILY PEDICULIDAE.

HISTORY.

This species has been known from the earliest times as a cattle louse though often confused with the next species. It was accurately described for the first time by Nitzsch in 1818. It has always been regarding as troublesome, causing a disease called *Phthiriasis*, demanding treatment.

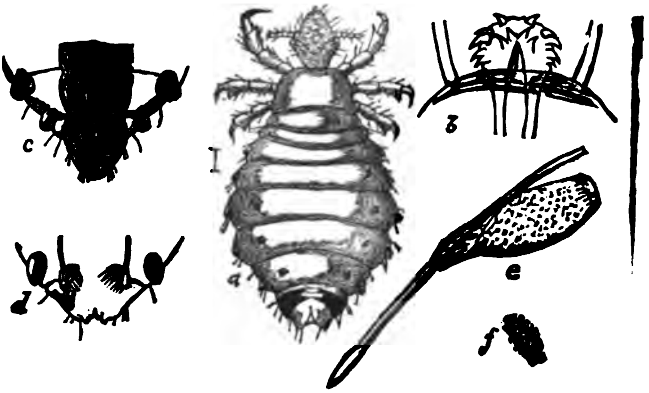


FIG. 1.

DESCRIPTION.

Females about one-eighth to one-half of an inch long and fully half as wide. Head bluntly rounded in front, nearly as broad as long. Antennae on the middle and side of the head, five jointed. Eyes very small, located upon low eminences just back of the antennae, front of the head provided with an extensible beak, which is armed with a double row of recurved hooks (See Fig. 1 b) by means of which the parasite is attached to the host. Also provided with a slender piercing tube by which blood is drawn from the host. Thorax broader than long, widest next to the abdomen. Legs, long, adapted for clasping. Basal joint of tarsus armed with a double plate bearing fine transverse ridges. Abdomen usually flat and flask-shaped, but variable according to degree of distention. A row of tubercles along each side, in which the spiracles (breathing pores) are located. Along each side of the upper surface a row of chitinous plates. There are two brush-like organs on the under surface of the next to the last abdominal segment, (See Fig. 1 d.) The upper surface of last abdominal segment black.

Males smaller and narrower than the females. There is a broad, black stripe upon the under surface running from the posterior end of the body forward to near the middle of the abdomen. (See Fig. 1 c.) The structure of the last segments of the abdomen of the sexes is quite distinct. (See Figs. 1, c and d.) The general color of both sexes is blue slate, though somewhat variable with sex, age and condition. The head and thorax are brown or yellowish. The tubercles at the sides and the chitinous plates chestnut.

Eggs minute, elongate, oval, tapering toward the base, which is attached by adhesive material to the hairs near the roots. Surface reticulate, the crossings armed with minute points. We do not know the time required to hatch, nor the number of eggs laid. The eggs are generally called *nits*. (See Fig. 1 e.)

The young escape from the upper end of the egg, which is provided with a cap-like lid. They are like the parents only smaller, and as they mature develop the chitinous plates.

LONG-NOSED OX LOUSE.

(*Haematopinus vitula, Linn-tenuirostris*, Burm.)

ORDER HEMIPTERA: FAMILY PEDICULIDAE.

HISTORY.

In connection with the previous species, this louse has long been known to cattle men and entomologists, though often confused with it, as both are often found parasitic upon the same animal. The specimens we have received this winter have all been of this species.

DESCRIPTION.

About one-eighth of an inch long and not more than one-third as wide. (See Fig. 2.) The head oblong, nearly four times as long as wide, and widest in the middle, just behind the antennae, set well back into a groove of the thorax and acute behind. Antennae five-jointed, located on the middle and side and usually extending forward. Thorax nearly twice as long as wide, with a breathing pore on the upper side opposite each of the second pair of legs. Abdomen oblong, wih nine segments. Devoid of chitinous plates or tubercles at the sides. Clothed, apparently, with small teeth, the outer row giving the edge of the body a finely dentate appearance. The terminal segment bilobed behind, each angle armed with about five rather long hairs. The two or three preceding segments bearing, on each side, two quite long hairs. The under side of the next to the last abdominal segment bears two brush-like organs. (See Fig. 2.) General color, bluish gray in adults. The life history of this species is much like that of the preceding species, though the details are no better known.

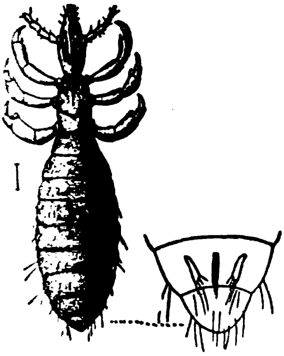


FIG. 2.

BITING LOUSE OF CATTLE.

(*Trichodectes scalaris*, Nitzsch.)

ORDER PSEUDONEUROPTERA: FAMILY PHILOPTERIDAE.

GENERAL CONSIDERATION.

This species of louse belongs to what are usually called bird lice (Mallophagans.) They are provided with mouth parts adapted for biting. They infest birds and animals, feeding upon the hairs, feathers, epidermal scales and waste products of the body of their hosts. They are said to have a suctorial organ and probably at times feed upon the blood. They are wingless, one family (Philopteridae) having the legs adapted for clasping and another family (Liotheidae) adapted for running. The bodies are usually horny and much flattened. The species are so numerous that there is scarcely a bird but what harbors one or more kinds. Some regard them as essential to the health of the host, that is, mutuals. They probably cleanse and beautify the feathers and remove wastes from the body. They injure animals less seriously than the true suctorial lice, as their principal food is wastes of the body. In great numbers, especially upon tender skinned animals, they are a source of much irritation, causing the animals to grow poor and lack vigor.

HISTORY AND DISTRIBUTION.

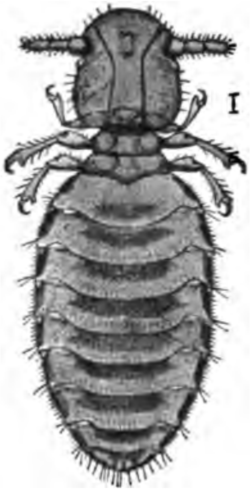


FIG. 3.

Abundant the world over upon cattle. First described by Linnaeus as *Pediculus bovis*. The present name was given it some time later and is adopted regardless of priority. The species is one of the best known animal parasites.

DESCRIPTION.

About one-twelfth of an inch long and of the form shown in Fig. 3. The antennae have only three joints, while the most of the bird lice have five joints to the antennae. There are dark bands across the abdomen as shown in Fig. 3. On account of the size and color they are called "little red lice" to distinguish them from the larger sucking lice that infest cattle and popularly named "blue lice." They are naturally more abundant in the spring. The eggs are attached to the hair and the young resemble in form the adults. Nothing is known regarding the number of eggs laid, the time required for them to hatch, or the time it takes them to mature, or the length of life. Here is an opportunity for some entomologist to distinguish himself, by tracing the life history of this and other species of cattle lice.

REMEDIES.

Lice irritate the skin. When animals are found rubbing they should be examined at once. If lice are found, separate the infested animals. Search about the neck and shoulders, at the base of the horns, around the eyes and nostrils, and along the back. Separate the hair and expose the skin. If lice are present they can generally be detected. A fine toothed comb could be used in searching. Infested animals are generally restless. When badly infested they lose flesh and the coat is staring. Bare places from rubbing appear on the neck and shoulders. It would be well to examine animals when they are put into winter quarters and not wait for pronounced cases before adopting remedial measures.

The authorized remedies for lice naturally divide themselves into four classes, viz: powders, unctions, liquids and fumes.

The powders usually employed are pyrethrum, ashes or road dust.

The unctions, mercurial ointment, and a mixture of kerosene and lard.

The liquids, decoctions of tobacco, stavesacre, or the seeds of the common larkspur; solution of carbolic acid soap, or kerosene emulsion. The fumes, burning tobacco, sulphur, or phyrethum.

Pyrethrum or Persian Insect Powder should be blown into the hair by means of a small pair of hand bellows until it is well filled. Ashes could be applied in the same way or sifted over the animal and rubbed in with the hand. Dry fine road dust can be used, and like ashes probably acts by stopping the spiracles of the parasite. This last seems to be nature's remedy, as animals will throw dirt over themselves when they have access to it. The unctions should be applied about the eyes, nostrils, base of horns, upon the neck and shoulders, and along the back. The decoctions are not practical remedies during the winter, unless the animals are kept in a warm room during treatment. The liquid remedies are probably the best and should be rsorted to when possible, especially in bad cases. The animals should be wet with the solution. Care should be taken that the solution is not too strong, and keep it out of the animal's eyes. The kerosene emulsion should be considerably diluted. The animals could be carded with a brush dipped in kerosene oil and the lice much reduced or destroyed.

Fumigation of the animals is sometimes resorted to, but it requires a tight box stall with a door behind and a wood stanchion in front. A canvas covering is made to fit tightly over the head of the animal, leaving only the eyes and nose exposed, while the other end of the canvas is tacked to the stall. Into this compartment through an opening, the burning tobacco, sulphur or pyrethrum is introduced. The time of exposure would vary with the strength of the fumes. Prof. Osborn found that the fumes from two ounces of tobacco and a half hour exposure was sufficient. Pyrethrum would probably do equally as well or better. The tobacco or pyrethrum could be burnt upon a piece of sheet iron heated by a small kerosene oil stove. r

EGGS OF THE LONG-NOSED OX-LOUSE.

Haematopinus Vitula, L.

After writing the article upon cattle lice we received from Mr. Batchelder specimens of hair with the eggs of the above species attached. As the egg had never been described and figured, we prepared the following account which appeared in Psyche, June 1895, but it should be put on record in the Station Report.

Professor Osborn says in his monograph "Pedicula and Mallophaga affecting Man and the Lower Animals" (Bull. 7, Div. Ent. U. S. Dept. Agric. p. 18) "that the eggs of this species have not been described, and we have not had the good fortune to discover them." Having been more fortunate we are able to submit the following account of the eggs of this species. The Long-nosed ox-louse has been quite bad this winter in herds in the vicinity of Thomaston, Maine. At our request Mr. A. W. Batchelder of Thomaston collected some hair from the infested animals, and upon this we found *three egg-shells* with the operculum off, but the form, sculpture, manner and place of attachment to the hairs seemed perfect.

DESCRIPTION.

Elongate oval, tapering toward the base. Slightly bulging on the side away from the hair in one specimen, or in the others narrower and more symmetrical. About two and a half times as long as wide. The empty shell hyaline and *beautifully sculptured with hexagonal reticulations.* The hexagons somewhat variable in size and perfectness in different parts of the shell, but average ones about one-twentieth of the width of the shell. The surface apparently smooth, the angles of the reticulations not beset with points as in the eggs of the Short-nosed ox-louse. Attached to the hair by a cement mass about one-third the length of the egg, as shown in the figure. The cement mass varies in shape, the distance it extends along the hair and the remoteness of the attachment from the root of the hair. The sloping base of the eggs is included more or less in the cement mass, and the eggs stands somewhat obliquely outward from the hair.

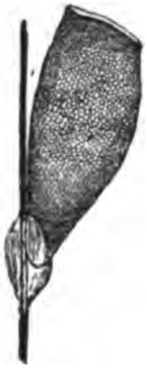


FIG. 4.

Below we give measurements of the three eggs observed. The figure, drawn to scale by the writer, shows the egg enlarged 40 times.

MEASUREMENTS.

Specimen (*a*,) length, .863 mm.; width, .38 mm.; width of operculum, .265mm.; from base of hair, 5 mm.; cement mass, .345 mm.; hexagonal reticulations of shell, .02 mm.

Specimen (*b*,) length, .805 mm.; width, .379.; width of operculum, .253 mm.; from base of hair, 5.75 mm.; cement mass, .288 mm.

Specimen (*c*,) length, .805 mm.; width, .379 mm.; width of operculum, .265 mm.; from base of hair, 10 mm.; cement mass, .312 mm.

THE YELLOW WOOLLY-BEAR.

Spilosoma Virginica (Fabr.)

ORDER. LEPIDOPTERA. FAMILY ARCTIDAE.

This insect was reported the past season as feeding on raspberry leaves. Though more commonly found on grapes it feeds upon various plants. The eggs are deposited in clusters on the under side of the leaves.

The young larvae feed in company for a time, but finely separate each going its way.

When full grown the larva is about two inches long and usually yellow, but sometimes straw color or brown. The segments are armed with yellowish tubercles which bear tufts of yellowish or brownish hairs. When ready to transform the hairs are woven with silk into a cocoon. The perfect insect called "The White Miller" appears in April or May. It expands nearly two inches and is pure white with a few black spots.

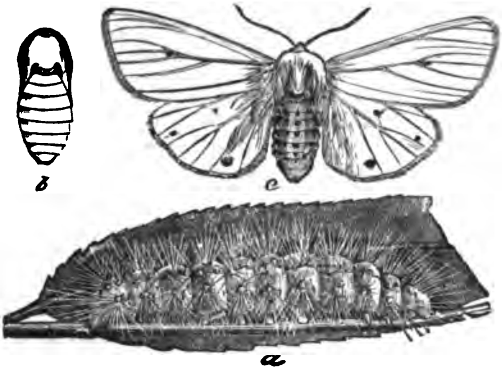


FIG. 5.

REMEDIES.

Hand-picking is the best method to keep them in check. The best time to destroy them is while the young are feeding in company and before much damage to the foliage is done.

THE TAPESTRY MOTH.

Tinea Tapetzella, L.

ORDER LEPIDOPTERA. FAMILY TINEIDAE.

A specimen of the above named cloths moth was received from Mrs. Andrews of Augusta. It was reported as eating holes in a carpet and a shawl. This is the rarest clothes moth found in Maine. Besides the above species that makes channels through cloth in which it works and does not make a case out of the fragment of the cloth, are two others which are quite common, viz: *Tinea pelionella*, L., which make little cases out of the cloth fragments in which it works, and *Tinea bisselliella*, which spins a cocoon found under the infected carpet.

The above mentioned species on account of its rarety is not likely to become much of a pest.

THE SPOTTED PARIA. STRAWBERRY LEAF BEETLE.

Typophrus Canellus, Fabr. var. gilvipes, Dej.

ORDER COLEOPTERA. FAMILY CHRYSOMELIDAE.

We received the following letter, No. 1, from Mr. Bray, accompanied by specimens, which we carefully examined and named as above. We wrote him to spray with Paris green at once, and also asked a number of questions stating that this insect had been known as a great pest to strawberry growers in other states, but had not before been reported as injurous to the strawberry or raspberry in Maine. In letters No. 2 and 3 will be found the reply. After reciving Mr. Bray's second letter, to be sure that we were right, specimens were submitted to Dr. Horn and Mr. Henshaw both specialists in Coleoptera, and they confirmed the name. The fact that this insect has done no damage to strawberries in Maine, and should take to raspberries and blackberries is somewhat remarkable. It is also strange that it should appear in noticeable numbers so suddenly. Below is given an account of the insect.

HEBRON, MAINE, April 30, 1895.

Professor Jordan:

DEAR SIR—I send you some raspberry canes and a few of the insects that are eating them. I have one acre of Cuthbert raspberries and they are covered with the insect enclosed. They eat into the buds as shown on the canes sent, and I fear will ruin the crop. I had a few of the same last year. They do not seem to fly around, but crawl up the canes from the ground. I shall try spraying with "Paris green", four ounces to fifty gallons of water, but do not have much faith that it will do any good. I think there will have to be something used on the canes that they will not like the smell of to prevent their crawling up. Please tell me what they are and what remedies I had better try.

Respectfully yours,
C. L. BRAY,
Hebron, Maine.

HEBRON, MAINE, May 14, 1895.

Mr. Harvey:

DEAR SIR—Yours at hand and in reply will say that I fear you have got the wrong insect. I have raised all kinds of small fruits for the past ten years including strawberries and have never noticed the insect before last year, and then only on raspberries. I got my first raspberry plants about ten years ago from A. M. Purdy, Palmyra, N. Y., and have increased my patch to one acre from them. I have sold plants to different parties and fail to hear of any injury being done to any of them with one exception. Last year was the first time I ever saw any of the insects, and where I raised in 1893, 80 bushels of berries I got only 30 in 1894. I sold about 1300 plants last year, but fail to find that the insect was seen on any of them after leaving me either last year or this. I have never seen any grubs in the ground except the large white grub that infests grass and strawberries. They are very numerous and I have about given up raising strawberries on account of them. There is hardly a green leaf on my whole acre, neither are there any sprouts coming up. They seem to be eaten off as soon as they break through the ground. They appeared in large numbers as early as April 15th or 20th, and damaged them so before I noticed them that I got discouraged and have not tried to do much with them. I put on about 30 bushels of wood ashes to the acre, and think that it checked them one-half or more until we had a rain when they seemed to be thicker than ever. They do not jump, but the least touch of the bushes or in walking through them talking or making much noise they will curl up and drop to the ground as though they could see or hear. I noticed they began mating about May first, but at this writing they have about all disappeared. About your questions will say:

First. They began mating about May 1st. I first noticed them about April 15th or 20th.

Second. I have never seen them jump and do not think they do.

Third. I saw them first in the spring of 1894, they were quite plentiful and did much damage.

Fourth. I have grown strawberries, but never saw them infested with this insect.

Fifth. I bought 100 plants from New York ten years ago, and and have increased my patch from them. Have sold a great many plants to different parties, but fail to hear of them being infested on any of them with one exception.

Sixth. I have never noticed any white grubs about the roots. Any further information that I can give you will be cheerfully given, as I want to be prepared to fight them next spring.

Yours truly,
C. L. BRAY,
Hebron, Maine.

Thinking it desirable to find out how widely this pest was distributed in the State, we put the following letter into the Bangor, Lewiston and Augusta papers.

ORONO, Me., May 13, 1895.

We desire to call attention through the columns of the Journal to a small black beetle about one-eighth inch long that is reported as climbing up raspberry canes and eating the opening buds. This is one of the worst pests to the strawberry grower, and should not be neglected.

These beetles hybernate and come out early in the spring doing great damage to the flower buds. They soon mate and lay eggs for a second brood. The grubs live in the roots of the plant and later appear as beetles and in the summer devour the foliage. Those killed now will prevent the increase.

The canes should be sprayed at once with Paris green, one pound to 200 gallons of water, or one pound of fresh white helebore to 50 gallons of water. To ascertain whether this beetle is common in the State and also to learn whether it has been known to feed upon raspberry plants, we would be pleased to hear from any one who has observed it; to make the matter certain, a few of the beetles and a cane with the buds injured should be sent in a wooden box, or, if working on strawberry leaves, the beetles only need be sent.

F. L. HARVEY, Entomologist,
Experiment Station.

In response to the above notice we received the following letter and a package of the above named beetle.

NORTH NORWAY, Me., May 16, 1896.

DEAR SIR—Noticing your communication to the Lewiston Journal in regard to the raspberry flea-beetle, will say, that a small brown jumping beetle, hard to catch, has done considerable damage to my half acre of Shaffer raspberries. Have not seen them on strawberries, but have seen them on blackberries, but they did but little damage. They are especially injurious to raspberries that leave out late. I have collected a few of the insects and mail them. They are not a jumping animal, but fall and play dead on being disturbed.

Yours truly,
W. C. SYMONDS.

Below we give letters received this spring just as we are completing our report and insert them as additional information upon this pest.

HEBRON, Me., May 12, 1896.

Prof. F. L. Harvey:

DEAR SIR—The bugs came on to my raspberries about April 20th, and it has been a fight between us two which would win, but it now looks, as you will see by the canes sent, as though the bugs would conquer. I have never raised but a very few strawberries and have never seen any of the bugs on them. Last year I looked the few vines I had over very carefully, but failed to find any of them. I have sprayed the most of the piece with Paris green, one to fifty gallons water, but can see no difference, and doubt very much if it will do any good as they take the bud before it begins to open and eat the inside all out, so you see it would be a difficult job to get the poison where they would get it. The only way that I can see is by hand killing. I have never seen any of the bugs jump, but they will roll off the bushes as soon as disturbed. I also send you a bug that is longer and lighter colored. (There seems to be two colors of the bug I sent you last year. One a shiny black, and the other a little reddish, perhaps male and female.) I find them quite plenty on the raspberry bushes that have got some leaves. The black bugs eat the sprouts in the ground, as you will see by the root sent.

Very truly,
C. L. BRAY.

NORTH NORWAY, Me., May 5, 1896.

Mr. F. L. Harvey:

DEAR SIR—The beetles referred to have appeared in large numbers. They can be seen flying on warm days near the patch. They attack everything in the shape of raspberries and blackberries, wild or cultivated. They have never yet done the blackberries much harm, seeming to prefer the blackcaps. They do not molest the strawberries close by. I did not spray last season. I have not noticed a second brood.

Yours truly,
W. C. SYMONDS.

HISTORY.

This insect was first reported injurious to strawberries in Canada, as early as 1873. Since then it has done considerable damage to strawberries. The larvae working in the roots and crown of the plant and the beetles eating the foliage. It is a general feeder (polyphagous) being known to feed upon juniper, walnut, hickory, black locust, hypericum, solidago, etc. Prof. Forbes reports it feeding upon raspberry leaves in 1884, but does not say it did serious damage. The cases referred to above would seem to be the first instances of great damage being done to raspberries and so far as we know, injury to the buds early in the season has not been reported. So far as we know it has never before been found feeding on blackberries. It has never been reported to the Station as doing injury to strawberries in Maine. That it should first appear in injurious numbers upon an unusual food plant is strange. The larvae have hitherto only been found in strawberry roots. It will be interesting to learn whether the raspberries were near strawberry patches, and whether the larvae attack the roots of raspberries and blackberries. The following description of the larva and pupa we take from Prof. Forbes' account, as we have not had them for study.

DESCRIPTION.

Larva—"White, 3 to 4 mm.; (.12 to .16 in.) long, and half as wide. The head and first segment pale yellowish brown." We have never seen larvae taken in Maine.

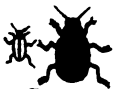


FIG. 6.

Pupa—"White except the eyes and mandibles which show red or black through the pupa skin. The head is bent against the breast and the legs folded against the body beneath."

Perfect Insect a small beetle about one-eighth of an inch long, usually polished black. The wing covers marked with longitudinal rows of pits. The thorax irregularly pitted with smaller depressions than those on the wings. The body stout. The legs brown.

Mr. Saunders says this insect is about three-tenths of an inch long. Out of sixteen specimens measured none exceeded 3.5 mm., and most were only 3 mm. or about one-eighth inch long.

He says: "pale in color—sometimes dark" having the wing covers spotted with black. Out of sixteen we mounted at random all are entirely black on the wing covers excepting one which had brownish elytra bearing *four* black stripes, two on each wing cover as shown in Mr. Saunders figure which we give above. We would think the reverse of Mr. Saunders' statement—usually black, sometimes pale—would be more nearly correct. Prof. Forbes in his Second Report, page 161, says: "In the lighter specimens the ventral segments and *three* spots on each elytron are black. Whether these variations in color are due to age, sex or food we do not know. It is evident that some careful work is still needed upon the habits and transformations of this insect. The eggs so far as we know are not known, nor the place of deposition. It is probable that these beetles hybernote, and the pupa that spring, but spent the winter in the beetle form about the roots of the plant.

REMEDIES.

Should the beetles crawl up the canes before the buds start or after the leaves unfold and before the fruit is formed spraying with Paris green would prove effectual.

Should they appear after the leaves and fruit are formed, as is usually the case, then it would be unsafe to use Paris green, and hellebore would have to be used.

Mr. Bray's experience would indicate that Paris green is not efficient. Certainly one pound to fifty gallons ought to kill them. A repellant or an insecticide that would injure the insect would have to be applied.

As the beetles probably hybernate it would be well to clean up all rubbish about the canes that would afford them winter shelter.

Hand picking though slow may have to be resorted to to check them.

THE CUCUMBER FLEA-BEETLE.

Crepidodera cucumeris, Harris.

ORDER COLEOPTERA. FAMILY CHRYSOMELIDAE.

A small black beetle about one-sixteenth of an inch long. The antennae and legs are yellow. The hind pair large and strong and adapted for jumping. Very abundant in Maine, early in the spring upon various garden plants, eating small holes in the leaves. It was reported as feeding upon petunias. The beetles spent the winter under rubbish or stones and are ready to attack the earliest plants. The larvae are said to live on the leaves attacked. There are several broods during the summer. The beetle enlarged is shown in Fig. 7. The short line at the left shows the real size.

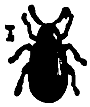


FIG. 7.

REMEDIES.

Sprinkle the leaves with hellebore powder or Paris green mixed with fifty parts of flour or plaster. Air-slaked lime or even ashes are said to be good remedies.

THE CURRANT FLY. GOOSEBERRY FRUIT FLY.

Epochra Canadensis, Loew.

ORDER DIPTERA: FAMILY TRYPETIDAE.

BIBLIOGRAPHY.

Loew—In Smith. Miss. Colls. 256. Monographs of the Diptera of North America Pt. III, p. 235, December 1873. Original description under the name *Trypeta Canadensis*, n. sp. from a Canadian or Maine specimen. *Epochra* is suggested as the more proper generic name. The female is described, evidently from a single faded imperfect specimen. Habits not stated.

Saunders—Insects injurious to fruits, 1883, p. 352. "This insect is occasionally found attacking the fruit of both the red and the white currant. In its perfect state it is a small two-winged fly, which lays its eggs on the currants while they are small; the larva enters them while stili green, and feeds on their contents, leaving a round, black scar at the point of entry. The affected currants ripen prematurely, and shortly decay and drop to the ground, when on opening them, there wil be found in each a small white grub, about one-third of an inch long, which when mature leaves the currant and probably passes the chrysalis state under the ground." The above is a full statement of Saunders' remarks in Insects Injurious to Fruits, p. 352.

Gillette, C. P.—Colorado Experiment Station, Bulletin No. 19, p. 18, May 1892. Account of its attacking gooseberries in Colorado. That the fly punctures the skin by a sharp ovipositor. The eggs were observed under the skin. The flies noticed ovipositing. The berries soon turn red and drop after being stung and the maggots remain in them for some time after they fall to the ground. The flies captured and identified. But one brood. Gathering the fallen infested berries suggested as a remedy.

Editors Insect Life. Injurious Insects of 1891 in Colorado. Review of above Bulletin, No. 19. Mere mention of the Gooseberry Fruit Fly (*Epochra Canadensis*, Loew.)

Snow, W. A.—Kans. Univ. Quar., Vol. 11, No. 3, 1894, p. 159. "One male (Maine) in poor preservation apparently belongs here. The wing agrees with the description; the stature of the body can hardly be called "short and rather broad;" the scutellum has four bristles.

Loew was in doubt whether the normal number of bristles on the scutellum was four or six. The reddish abdomen is black at the base and on the two distal segments, but this coloring has much the appearance of being the result of dessication." The above is a full statement of Prof. Snow's remarks, which we insert because they may not be readily accessible, and because we refer to them under *Critical remarks.*

HISTORY AND DISTRIBUTION.

This species was first considered by Loew in 1873, from a single faded female contributed by OSTEN SACKEN. OSTEN SACKEN'S material may have come from Maine, as he gives Norway, Maine, as the locality, the specimens having been collected by S. J. Smith. Loew gives Canada as a locality upon the authority of Mr. Provancher. How long the species had been known before it was described does not appear, but Osten Sacken says it "seems to be common in those regions." If its habit of infesting currants was known in 1873, no mention is made of it. It is next considered by Saunders in 1883. During the intervening ten years its currant infesting habit became known and some attempts were made to determine its life history.

In 1891, Prof. Gillette found it very abundant in Colorado, infesting gooseberries. This being the first authentic account of its infesting that fruit. Prof. Gillette also added many facts regarding the life history as given above.

Prof. Snow in 1894 examined a single male and contributes the fact, that the bristles on the scutellum are four.

Regarding the single male specimens considered by Prof. Snow, (See bibliography above) he gives us the following: "My single specimen of *Epochra Canadensis* is from the Yale collection and I found it among Dr. Willeston's flies. There is no label upon it except "Me." and Dr. W. can give me no farther information."

We find no reference to this insect in the Agricultural and Horticultural Reports of Maine, and if it has done injury heretofore it has not been recorded.

Mr. Z. A. Gilbert says he was formerly troubled by such an insect, but stopped growing currants for a time and then resumed and has not been troubled since. Mr. D. H. Knowlton, Farmington, says his currants have been infested for several years.

Our first knowledge of this insect was in the summer of 1894, when Prof. Jordan called attention to the fact that a large number of the currants in his garden in Orono was dropping, and that the fallen fruits each contained one or more white maggots. The only reference found to such a currant insect was the few words regarding *Epochra Canadensis*, Loew, in Saunders Fruit Insects, p. 352.

The serious nature of the injury being a matter of importance, and the fact that the life history was apparently almost entirely unknown led us to seriously begin the study of its habits. We were strengthened in this resolution after finding that the description given by Loew was drawn up from a single female. We did not then know of Prof. Gillett's observations, which are accurate in the main but general, and we trust the more detailed study we have made will be helpful. We were interested in comparing the life history of this insect with *Trypeta pomonella*, Walsh, which we studied in 1888-9. The experience gained in the study of that insect has aided us very much in the study of this. We studied the larvae and pupae in the summer of 1894, and in the spring of 1895 considered the flies, their eggs, and the method of ovipositing, completing the life history. The following results of our study are humbly given hoping they may contribute to a better knowledge of this injurious insect.

The following data which probably refers to *Epochra Canadensis* lacks sufficient confirmation.

Mr. L. O. Howard informs us that in the notes of the Division of Entomology at Washington are the following facts: "June 15, 1885, package of currants and gooseberries infested with larvae evidently of *T. Canadensis* was received from G. L. Colfax, Washington (State.) The adults were not reared. "July 11, 1892, package of gooseberries infested by what is evidently the same insect was received from D. Thurston, West Ferndale, Washington (State.) The larvae were dead when received.

To gain farther information we addressed a letter to Mr. Thurston and received the following reply.

West Ferndale, Whatcom Co., Wash., July 7, 1895.

Prof. Francis L. Harvey, Orono, Maine.

Dear Sir—Yours of July 1st to hand. During the years 1890, '91, '92, I noticed my currants (black, white and red,) also gooseberries badly troubled with the worm you refer to. In '93 I was at the World's Fair and could make no observations. In '94 I did not notice any, (my attention not being specially directed to the subject.) This season, '95, at your request I have just looked over my small fruit and failed to find a single specimen! although in the years referred to they were so abundant as in '92 to spoil one-third of the gooseberries and black currants. The only reason I can give for the change, is that for the past few years, I have allowed the young chickens to run at large in the berry patch, and during fall, winter and early spring I allowed the large fowl to run at large also, and they may have exterminated the larvae after they had reached the ground. When I pick the crop if I find any wormy specimens I will forward them.

I remain yours truly,

A. W. THORNTON.

We addressed a letter to Prof. James Fletcher regarding its occurrence in Canada, and below is given his reply.

My Dear Prof. Harvey.

Your letter of July 23rd has been forwarded to me. The only place in Canada, from which I have received complaints of *Epochra Canadensis* is British Columbia, where I am told that in many places the black currants are rendered unusuable owing to the numbers of white maggots which came to the surface when these are cooked. This is presumably *E. Canadensis* although I have been unable to secure any specimens. I have received complaints concerning them for the last thirteen years. At one place, Cowichan on Vancouver Island, I was told in 1885 that black currants could not be used at all on this account.

I have been unable to find any specimens in gooseberries, although the large handsome fruit of *Ribes Lobbii* (a gooseberry) is certainly attacked by some larvae on Vancouver Island.

Regretting that I am unable to give you more information.

Believe me to be yours truly,

J. FLETCHER.

Mr. Wm. Cann of Topsam, Maine, writes us that his curants in 1895 were stung and a maggot was formed inside. No specimens were sent, but it was probably the above insect.

From the above data it is quite certain that *Epocha Canadensis*, Loew, is a native American species, distributed throughout the northern part of the United States, and in Canada, extending from the Atlantic to the Pacific coast. It will be interesting to determine whether it infests native currants and gooseberries and from them has transferred it depredation to the cultivated varieties.

OBSERVATIONS—HOW DOES THE FLY OVIPOSIT.

She runs over the currant in a nervous restless manner keeping the wings in a constant fanning motion. Often examines carefully several currants before finding one to her fancy. Usually one of the large currants in the upper part of a bunch that is in the shade is selected. Then coming to rest the last three segments of the abdomen are turned at quite an angle forward under the abdomen. The hind feet are set bracing backward and outwards. Then the truncate end of the last segment rests on the currant and the ovipositor is protruded making a puncture. The probing continues very rapidly for fully five minutes at least, a plunge is made in every second. The last segment is occasionally raised during the process showing the protruded sheath of the ovipositor and the ovipositor inself. Finally the plunging motion changes to a vermicular movement of the abdomen to expell the egg which lasts about half a minute when the ovipositor is withdrawn, and the deed is done. The mouth parts are constantly in motion during the process. But one egg is laid in a place.

NATURE OF THE REPRODUCTIVE SYSTEM.

We dissected several females and found the ovaries double. The eggs giving the abdomen a swollen appearance and filling the abdominal cavity. The egg masses consisted of about ten chains of eggs on each side, each chain in about ten stages of development, making the possible number of eggs the flies are capable of laying fully 200.

The developmental stages are strikingly like those of *Trypeta pomonella*, figured in our 1889 Report, and as in that insect the egg laying period must extend over considerable time.

WHEN DO THE FLIES EMERGE.

Specimens kept in jars in a warm room began to emerge the last week in April, but in nature were first noticed about June first. They were mating at that date and punctures on the currants were abundant indicating an earlier emergence than June 1st. The time varies with the season and locality. No flies were seen in 1896 before June 5th.

HOW LONG DO THEY CONTINUE ON THE WING.

Specimens were quite abundant about the first of June, were most abundant from June 9th to 15th, and by June 25th more were to be seen about the bushes. Making allowance for difference of time of emergence the period of flight would not be over a month at the longest.

WHAT IS THE NATURE OF THE PUNCTURE.

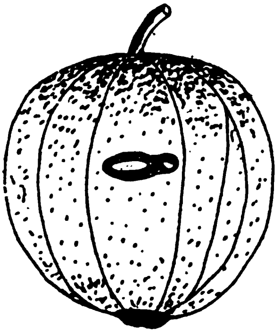


FIG. 7-a. Currant showing the relative position of the puncture and deposited egg.

It is scarcely visible at first but soon becomes surrounded by a brown areola and then is shown to be nearly circular and about a half mm. in diameter. Extending from it at one side is a narrow portion of the epidermis from which the sub-epidermal cells have been removed by the ovipositor, giving it a semi-transparent appearance through which the egg can be clearly seen close under the skin to one side of the puncture.

This portion of the epidermis covering the egg soon becomes whitish, opaque and sunken. We were at a loss at first to know how the egg could be deposited so close to the skin at one side of the puncture but a study of the protruded ovipositor shows that it turns backward at right angles near the end, so that the egg is inserted at an acute angle backwards to the position of the last segment of the abdomen during the deposition. An examination of Plate I, Fig. 9, which shows the protruded ovipositor will make this plain. The end of the egg opposite the pedicel is the one inserted first as shown by the eggs in the oviducts and the position of the deposited egg to the puncture. It is from this end that the larva emerges. We have in this species another instance of deposition of the egg under the skin of the fruit by means of a sharp ovipositor, as in *Trypeta pomonella*, Walsh.

EGG LAYING PERIOD.

The eggs are laid one in a place occupying about five minutes for the deposition. The insects are capable of laying fully 200 eggs. The time they are on the wing is about three weeks. This would require that several be deposited each day. An examination of the ovaries showed that about two eggs of each chain or about twenty were practically perfectly developed. The short life period would require rapid maturation of the eggs. If ten were laid each day three weeks would be required to complete ovulation. They may be deposited even faster than this.

THE FLIES SINGLE BROODED.

Specimens of the pupae taken from the ground under the bushes, about the time the currants were mature, remained in the ground in a warm room all winter but did not emerge until April. Those in nature emerged about June 1st. The insect therefore spends about eleven months of the year in the ground.

HOW LONG DOES IT TAKE THE LARVAE TO MATURE.

The larvae began to emerge June 20th. An examination of many currants at that date showed that quite a per cent contained full grown larvae. The deposition of eggs began about June first which would indicate three weeks as the time required for full growth. As we found at this date larvae from two mm. to seven mm. in length it would extend the time that the fruit is infested from the laying of the first eggs to the maturity of those last laid which would be fully six weeks. Our observations indicate that the larvae do not leave the fruit as soon as matured which would extend the time still farther. We had some larva pupate as late as July 15th.

NATURE OF THE WORK OF THE LARVAE.

When hatched the larva is about one mm. long and as soon as it emerges from the egg begins to travel, often leaving a delicate light colored trail close under the skin which can be seen through it. This is not always the case. After traversing from a third to a half the distance around the currant it locates, entering in most cases one of the seeds, disappearing entirely within it. Sometimes the larva locates near the puncture and sometimes the exit hole is on the opposite cheek from the puncture. As it grows the head finally protrudes from the seed as shown in Plate I, Fig. 7. After feeding upon the contents of a seed and having grown too large to find lodgment within it, it locates between the seeds in the pulp and then gnaws holes in the seeds eating the contents of one after another until often the contents of at least half a dozen are consumed before the larva is grown. They seem to reject the coats and the clear gelatinous envelope that surrounds the seeds. The refuse of the seeds eaten turns black and becomes cemented together. A black spot becomes visible through the skin. The location of the larvae can be told readily as the currants infested soon begin to show a clouded appearance where they are located. That cheek turns red earlier and rapidly a deeper red and finally a black spot. Infested fruits ripen earlier. Often half grown larvae will be found with the head end half buried in a seed. Finally when full fed the larvae gnaw to the surface and cut a circular hole about 1.5 mm.d. through the epidermis by means of which they emerge with ragged edges.

Do the Currants Drop While the Maggots are Still in Them.

On June 22nd we collected several hundred currants that had fallen on the ground. One hundred of them were carefully dissected and every one contained a maggot excepting two from which the maggots had emerged leaving the evidence of their work. (We put about two hundred of the currants in a box and on June 24 twelve pupae were found.) The maggots were of various sizes from 2.5 mm. to 7 mm. showing that the currants often drop before the maggots are mature. On the same date we took quite a number of currants from the bushes that were turning red. They were the large ones at the base of the bunches and invariably were infested by a maggot. The maggots were of various ages, some full grown, but would not average as large as those found in the currants on the ground.

Do the Larvae Leave the Fruit as Soon as It Falls.

An examination of currants picked from the ground under the bushes contained larvae of various ages, 7 mm. 4 mm. 3 mm. and 2 mm. in length.

Put quite a number of infested currants in a box June 22nd and some of them did not emerge and pupate before July 15th. The most however emerged in five days.

Quite a number of currants were found on the bushes containing evidence of aborted work showing some mishap to the egg or developing larvae. There were others which showed an exit hole proving that quite a number of the maggots drop to the ground from the currants before they fall. Quite a number of currants showed more than one egg puncture and several from two to three live and flourishing larvae.

ARE ALL OF THE FRUITS IN THE BUNCHES AFFECTED.

The inflorescence of the currant is racemose and the fruits at the base develop first and are first in condition to receive eggs. In these the earliest laid eggs are placed. The currants at the ends of the bunches were exempt and ripened good fruit after the flies were done ovipositing.

WHERE DOES THE INSECT SPEND THE WINTER.

When the larvae are ready to transform they crawl out of the currants and enter the ground a short distance if it is suitable, or they may transform on the surface under rubbish. They may be found in abundance in the ground under the bushes in the fall. The larval skin is not cast but the larva shortens up becoming a coarctate pupa of a pale yellowish brown color. In this condition the insect spends eleven months of the year gradually undergoing changes into the fly which emerges the following season.

GENERAL DESCRIPTION.

Perfect insect a two-winged fly about the size of a house fly. Pale yellow or orange with greenish iridescent eyes and dark bands across the wings. Found about currant and gooseberry bushes during June in Maine. Stings the currants, depositing an egg under the skin, that hatches and develops into a small white maggot causing the fruit to turn red and drop prematurely. The maggots when grown leave the fallen or hanging fruit, enter the ground, change to the pupa state from which the fly emerges the following June.

TECHNICAL DESCRIPTION.

Female Fly—Pale clay-yellowish or in darker specimens pale orange. On the border of the front on each side, are three or four long, but rather weak black bristles which curve toward each other. Between the ocelli and the last bristle on the border of the front is a single bristle that curves toward the vertex. On the vertex near the eye two bristles the inner much longer. Antemae darker yellow than the head, third joint rounded at the tip; arista blackish, yellow towards the base, with a very short pubescence. Rostrum and palpi pale yellow, the latter not reaching beyond the anterior edge of the oral opening. Thoracic dorsum with a very thin, whitish bloom, a double middle stripe and a narrow lateral stripe, rather shining and somewhat darker than their surroundings. The posterior end of the thoracic dorsum and the scutellum, shining, very pale yellow; a not very broad yellowish stripe runs from the humeral corner to the root of the wings. The scutellum convex and not very large; bristles on the scutellum four. The bristles of the thorax and of the scutellum, as well as the short pile of the thoracic dorsum, are black. Metathorax distinctly infuscated on its superior margin and its middle line. Abdomen shining, with short black pile; the fourth and fifth segments marked by a chestnut brown or black cross band interrupted in the middle, the third usually and sometimes the second segment with a lateral beginning of such a stripe indicated by a chestnut-brown or black spot. Pale specimens without abdominal markings excepting upon the long seventh which in all specimens is dark on the proximate dorsum and at the distal end. Seventh segment equal to the three preceding segments taken together, very broadly truncate and infuscated at the end.

The seventh segment contains the retractile sheath of the ovipositor and the ovipositor. The sheath is clyindrical, broadest at the ends. Clothed with retrorse scales arranged in six longitudinal bands at the base which are brownish toward the end and becoming black near the base. Toward the end the scales become smaller and cover the whole surface, and at the middle the six bands are merged into four.

The ovipositor provided with two guides which are flat, obtuse at the ends and extend three-fourths its length. The ovipositor brown, flat, serrate on the edges, each edge with three teeth. The basal tooth remote. Both faces of the distal lateral teeth each bear two rows of five black bristles. See Plate II. The tip pointed. The principle is that of a double edged serrated hay knife or a *Crysty Bread Knife.*

The front femora are sparsely beset with bristles upon the upper and under side; the middle femora are entirely without bristles; upon the hind femora, likewise, there are only a few bristle-like hairs before the end of the upper side; the upper side of the hind tibiae is merely beset with exceedingly short bristle-like hairs. Wings of the usual shape, hyaline, with a pale-brown picture or in darker specimens nearly black; it consists: 1. In an oblique half cross-band running from the humeral crossvein to the basis of the second basal cell; 2. Of a crossband parallel to the first, abbreviated behind, which begins at the stigma, near the anterior margin, and runs across the basis of the submarginal cell, as well as across the cross veins, which close the second and third basal cells, and thus reaches the sixth longitudinal vein; 3. Of a rivulet which begins above the posterior crossvein, near the third longitudinal vein, runs from it across the posterior crossvein as far as the posterior margin, is continued along this margin inside of the third posterior cell, but, before reaching the sixth longitudinal vein, is suddenly turned upwards, running parallel to the band which begins at the stigma, crossing the small crossvein, and thus reaching the anterior margin, where, gradually expanding, it forms a border ending a little beyond the tip of the fourth crossvein. The two cross-bands as well as the rivulet, are of moderate breadth only; the latter has, in the described specimen, the following faded spots, which, in more fully colored specimens, are probably less apparent or altogether absent. 1. A rounded spot in the marginal cell, above the origin of the rivulet; 2. Upon the longitudinal axis of the submarginal cell an indentation in the inner margin of the section bordering the apex of the wing; 3. Upon the longitudinal axis of the first posterior cell an interruption of the rivulet at its origin and an indentation in the inner margin of the portion bordering the apex of the wing; 4. Upon the longitudinal axis of the discal cell a narrow interruption of the section, running again towards the anterior margin; 5. The spot upon the posterior margin connects the first, descending, portion, with the second, which rises again upwards. The first and third longitudinal veins are bristly; the third and fourth are parallel towards their end, both very gently curved backwards; the section of the fourth vein preceding the discal cell is gently, but rather distinctly arcuated backwards, so that the shape of the discal cell somewhat reminds of that of the species of Rivellia; the crossveins are comparatively rather long, moderately approximated, their distance being about equal to the length of the posterior crossvein; the latter is rather steep, however, perceptibly approximated to the apex with its anterior end, more than with the posterior; the posterior corner of the anal cell is very much drawn out in a point.

Male Fly—Pale clay yellow to pale orange. Smaller than the female and the color and wing picture the same but paler. The head and eyes as in the female. In front view about as long as broad with mouth up, anterior distance between the eyes only half as great as the posterior. The three ocelli brownish. Three long, weak black bristles upon the border of the front as in the female. On the occiput just above the neck are two clusters of six black hairs each, that lie parallel to each other. The antennae darker yellow than the head. The terminal joint twice as long as broad, rounded at the end and not reaching the mouth. Palpi and rostrum yellow the former not reaching beyond the mouth. Arista black, pubescent yellowish at the base.

The thoracic dorsum bears a faint double median stripe and also a narrow lateral stripe. The pollinosity in our specimens seems to be continuous over the whole surface and not absent from the stripes as described by Loew. The entire thoracie dorsum covered with short black hairs excepting the posterior portion. The scutellum is naked excepting that it bears *four long black bristles.* Post border of scutellum dark colored and together with a median dark stripe on the posterior metathorax makes a T shaped marking. Sides of thorax armed with five long black bristles. Four shorter weaker hairs on anterior of thorax. Halteres pale.

Femur of the anterior pair of legs armed with long black bristles. Femur of other legs unarmed. The two posterior legs darker. Abdomen oblong, arched, width to length as 5:8. Composed of six segments, ratio 3:4:4:4:5:2. The basal bears an obscure median dorsal brown spot. The posterior portion of the abdomen darker yellow.

Fourth and fifth segments each bear an obscure brown spot on the lateral dorsum. Part border of the narrow sixth segment dark brown but usually turned under the abdomen so that from above the end of the abdomen appears yellowish. There is a row of ten long bristles on the posterior border of the fifth segment (see Plate I, Fig. 10.) Attached to the lower surface of the sixth segment is the external genital apparatus composed of claspers, guide and penis. The claspers are club-shaped and notched near the posterior end on the interior edge. The guide between the claspers is a horse hoof shaped organ half as long as the claspers ending in a tuft of hairs and backward narrows into a small pedicil. The penis is exceedingly long, bearing at the end an enlargement to which is attached a pedicilate pear-shaped appendage. See Plate I, Figs. 8 and 10.

The wings as in the female.

Measurements of Male Fly.—Total about 6.5 mm. Head .931 mm. long, depth .1064 mm. exclusive of rostrum, breadth 1.729. Width of eye from dorsal view .399 mm. Front view nearly round, about .745 mm. with mouth up anterior distance between eyes .675 mm. posterior, 1.33 mm. Arista 2.93 mm. Thorax 2.13 mm. long. Abdomen 3.46 mm. long, 1.33 mm. wide. Segments in the ratio 3:4:4:4:5:2.

Eggs—Opalescent white, oblong, pedicelate. The pedicelate end more pointed than the other which is somewhat obtuse. The pedicel with a short narrow neck and bulbous at the end. The pedicelate end for about one-third of the length sculptured by raised lines arranged in a hexagonal pattern giving a rough pitted surface, most conspicuous near the pedicel and gradually lost in the smooth surface of the opposite end, about four and a half times as long as wide. They measured 1.064 mm. by .24 mm. in one specimen and 1.04 mm. by .25 mm. in another. (Plate I, Fig. 2.)

Larva—Length 7 mm. (.28 in.); breadth 1.5 mm. (.06 in.) White with sometimes a faint rosy tint, probably due to absorption of the colored juice of the currant. Footless body composed of about thirteen segments. Widest in the middle, tapering rapidly toward the head, which is small, pointed and emarginate. (Plate I, Fig. 3.) The mouth circular surrounded by a zone of ridges and furrows. From the mouth protrudes two curved parallel retractile black hooks, the *rasping organs* of the larva, by means of which it gnaws the fruit. (Plate I, Fig. 6.) The chitinous frame work to which these hooks are attached shows as a black area in the second and third segments. These hooks and frame work give the end of the head a black appearance. There are two pairs of tubercles upon the front of the first segment. The lower pair smaller. (Plate I, Fig. 6.) The cephalic and candal spiracles are yellow. The former between the third and fourth segments and lacerate funnel formed. The latter are on the posterior face of the last segment and end in three finger like thorns. (Plate I, Fig. 5.) These are connected by trachea with large anastomosing branches at the posterior and anterior ends. The larva when first hatched is about 1 mm. long, and slender

This larva looks much like that of *Trypeta pomonella* and could not be separated without a hand glass, but the mouth, head and candal spiracles are quite distinct.

Pupæ—Five mm. long by nearly 2.5 mm wide, broadly oblong, straw colored, coarctate. The head end more pointed and showing the cephalic spiracles. The candal spiracles also apparent. In emerging the fly breaks away the lower half of the first four cephalic segments. The pupa is shown in Plate I, Fig. 4.

CRITICAL REMARKS.

Mr. Loew says in the introduction to Part III of his "North American Diptera" (Smithsonian Miss. Colls. p. 213) I have been compelled to draw the descriptions of several species from single, often badly preserved specimens, and I am afraid that these descriptions * * * may sometimes betray the incompleteness of my material." Appreciating this fact the critical remarks made below are not given in the spirit of a criticism but to supplement what has been written after the careful examination of an abundance of material. Loew must have examined faded or pale colored specimens as the larger and better developed individuals have the abdominal markings dull black and also the markings on the wings are much too dark to be described as having "a pale brown picture." There are occasionally females with slender abdomens which are without markings. These seem to be *unimpregnated* or possibly through ovipositing. The intensity of the color in others is variable. There is a dark uninterrupted band across the posterior border of the sixth segment. Loew calls the last abdominal segment of the female the ovipositor, a mistake which entomologists made in regard to *Trypeta pomonella*, Walsh. The last abdominal segment is about as long as the three preceding, conical, truncate at the end, and retracted within it are sheath and ovipositor. Mr. Loew evidently did not see the ovipositor which we have described and figured. (See Plate II.) He also makes a mistake regarding the number of abdominal segments, there being *seven* the one at the base having been overlooked. Therefore, the description given by Loew, "the third and fourth segments have, each at its basis, a chestnut cross band interrupted upon its middle, while upon the second segment only a lateral beginning of such a stripe is indicated by a chestnut brown spot," would have to be corrected by saying fourth and fifth and third segments respectively. Mr. Loew is in doubt regarding the number of bristles upon the scutellum, which we find is four upon *both* male and female. In the brighter colored flies there is a decided orange tint, which would require a modification of the statement that the color is "pale clay yellowish." We find that the number of bristles on the border of the front is usually three on each side; but it varies from two to four. In some specimens three on one side and four on the other. Mr. Emerton's drawing (Plate I, Fig. 1) shows four.

Saunders says it "lays its eggs on the currants while they are small." Our observations are that the eggs are inserted under the skin through a small hole made by the sharp ovipositor, and that the currants are quite large before the eggs are laid, and that the largest ones at the base of the bunches are usually selected first. He also makes a mistake when he states that the larvae leave "a round, black scar at the point of entry." The young larvae usually travel some distance from where the egg is deposited before establishing headquarters. The black scar locates the larva, and results from the decomposition of the parts injured and the exuviae of the larvae. The *exit* hole of the larva is usually located in the black scar. The puncture made to lay the egg is too small to be noticed excepting by close examination. He also says the insect "probably passes the chrysalis state in the ground, a guess which is confirmed by finding the pupae in abundance in the ground under the bushes.

Prof. Snow correctly doubts that the abdomen of the male is "short and rather broad," but the black of the abdomen in well colored specimens is natural. The abdomen of the female varies from very narrow in unimpregnated specimens or those through depositing to every broad in those full of eggs. The abdomen of both shrivel and change form in drying, and the colors are duller. The abdomen of the male has but six segments, and from that reason is shorter than that of the female though the segments preceding the sixth are larger than those of the female.

We are at a loss to know how Prof. Snow can arbitrarily "consider six as the number of segments composing the abdomen of the female trypetid and five as composing that of the male," when nature has decided the matter by giving the former seven and the latter six. Certainly it can lead to nothing but confusion as has Loew's discrepancy in the correct number. We can't even see any good reason for longer perpetuating the error that the long terminal abdominal segment is the ovipositor, for it certainly has nothing to do with ovipositing. It is not inserted at all into the puncture and merely has the ovipositing apparatus attached to it and when not in use telescoped within it. The fine plate which we give of the ovipositor from the pen of Mr. Emerton should settle this matter.

There are also six well defined segments separated by sutures in the male abdomen in front of the external male genitalla as shown in Plate I, Fig. 10. The terminal segment is, however, short.

Prof. Gillette's observations of the habits of this insect agree with ours very nearly, though he studied its work upon gooseberries instead of currants. We are, however, of the opinion that the currants stung remain on the bushes much longer than he records for gooseberries, and that the red spot develops where the larvae is located instead of where the egg is deposited. In currants the egg is not laid in the pulp, but at one side of the puncture close under the skin, so it can readily be seen through it.

The figure of the fly given shows but four abdominal segment, anterior to the long terminal one while there are really six. The thorax dorsum is not of uniform color as shown, but is faintly double striped down the middle and at the sides by the absence of the whitish bloom that covers the upper surface. See Plate Fig. 1. The thorax is too long and the head too narrow and small.

We find that quite a number of the maggots leave the currants before they drop. This may not be so with gooseberries. For currants we can not recommend gathering the fallen fruit as only a partial remedy.

REMEDIES.

We have had no experience with this insect as it is new to Maine as an injurious species. From a study of its life history we discover only one vulnerable point. The insect spends eleven months of the year in the ground and can not be reached. In the winged stage it cannot be destroyed so far as we know. The eggs are deposited under the skin of the fruit and spraying would do no good. *Part of the infested fruits drop prematurely and the worms remain in them for some time before they emerge and go into the ground.*

(a) Based upon this last habit we would recommend gathering up the fallen currants frequently and burning them.

This remedy cannot be relied upon to destroy *all* the flies as quite a number of maggots leave the fruit before they fall. It can be depended upon to destroy fully half if not more and can be employed to keep them in check.

(b) As these flies are weak and liable to perish if any obstruction is offered to prevent their coming out of the ground,we would recommend a mulching of coarse straw or hay, several inches deep, placed under the bushes and out as far as the branches extend, and well packed.

(c) As the larvae find fine dry dusty substances prejudical to their transformation a heavy dressing of coal ashes placed under the bushes in June would destroy many of the larvae and also prevent the flies from emerging the following spring. Prof. Jordan tried this on his garden without flattering results.

(d) Our western correspondent Dr. W. A. Thornton thinks that allowing young chickens about the bushes early in the season and large fowls later after the fruit is gathered will keep them in check.

(e) A radical remedy would be to pick and destroy the crop after the eggs are largely laid and before the currants drop, or pick the entire crop while green and before the flies appear. If there are no currants of course no eggs could be laid, and the flies would have to go elsewhere or perish.

(f) As the pupae are found only about an inch below the surface, they could be destroyed with little trouble by removing the soil to that depth from under the bushes and burying it deep or depositing it on a road or some exposed place.

(g) We have not discovered any parasites to help check the pest. Short bearing years would tend to reduce the numbers.

Maine State College Experiment Station Report. 1895. Plate I.

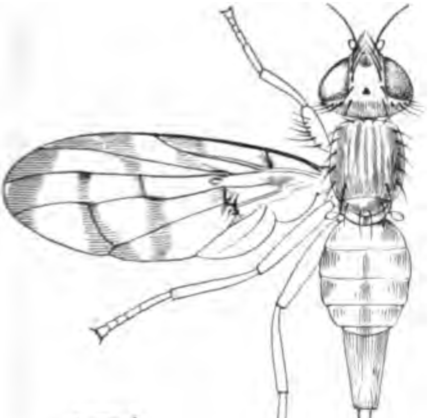
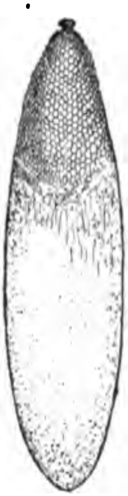


Fig. 1.



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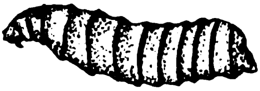

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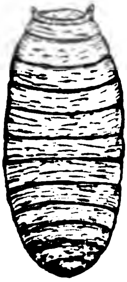

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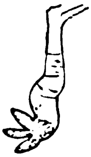

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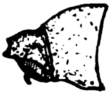

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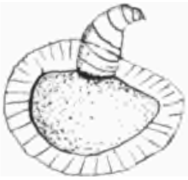

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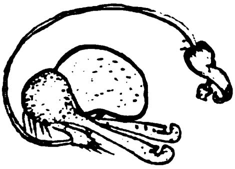


Fig. 8.

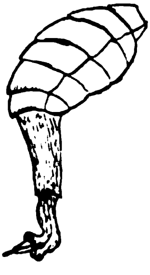


Fig. 9.

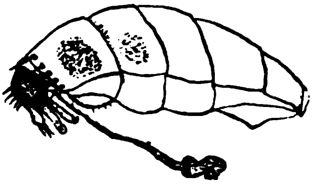


Fig. 10.

The Currant Fly, Gooseberry Fruit-Fly.
(*Epochra Canadensis, Loew.*)

EXPLANATION OF PLATE I—THE CURRANT FLY.

(*Epochra Canadensis*, Loew.)

All excepting Figure I were drawn by the writer.

Figure 1. The female fly enlarged about seven and a half times. Drawn by Mr. J. H. Emerton from slides of the wing and ovipositor prepared by the writer and from pinned flies. The two basal joints of the abdomen are drawn as one. The real number, including the long terminal segment is seven instead of six.

Figure 2. Egg showing form, sculpture and pedicel, enlarged fifty times.

Figure 3. The larva enlarged about five times.

Figure 4. The pupa enlarged eight times.

Figure 5. The candal spiracle of the larva much enlarged.

Figure 6. First two segment of the head showing the tubercles on the head, the rugose mouth and the rasping organs. Enlarged twenty-five times.

Figure 7. Seed of currant with gelatinous envelope showing larva protruding from it. Enlarged.

Figure 8. External genitalia of male. Enlarged twenty times.

Figure 9. Side view of abdomen of female with ovipositor protruding and bent backward in the position it takes as the egg is deposited under the skin to one side of the puncture. Enlarged.

Figure10. Abdomen of male with gentalia and showing six segments. Enlarged.

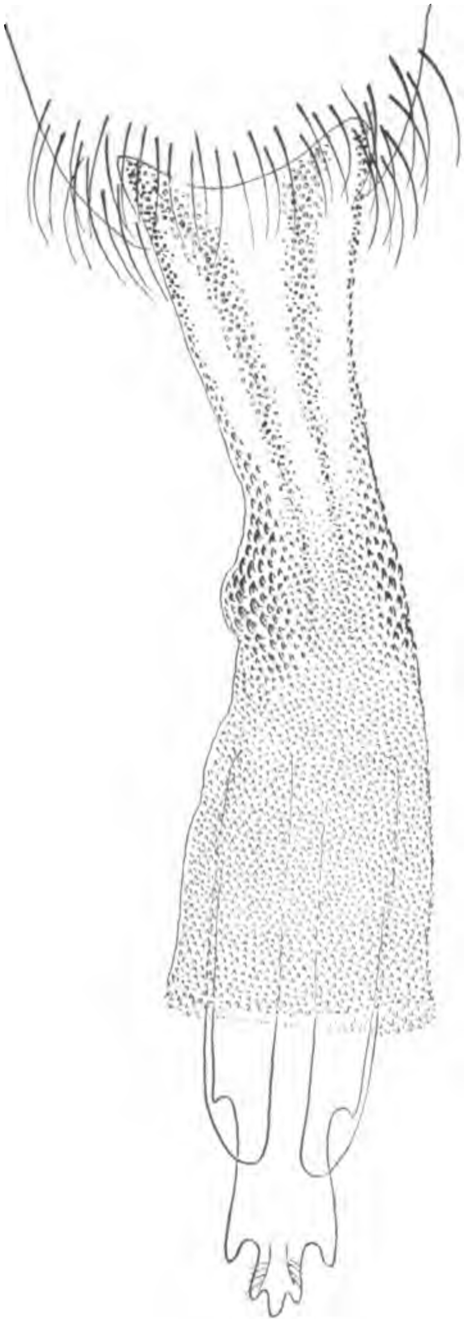
EXPLANATION OF PLATE II—THE CURRANT FLY.

(*Epochra Canadensis*, Loew.)

This plate prepared by Mr. J. H. Emerton from dissections made by the writer, shows the end of the last abdominal segment; the sheath of the ovipositor; the guide; the ovipositor; the bristles terminating the abdomen; the triangular scales that point backwards and cover the most of the sheath; the teeth upon the ovipositor and the small bristles near the end.

When not in use the ovipositor and guides are telescoped into the sheath and the sheath into the long terminal abdominal segment. The figure is enlarged one hundred and twenty times.

Maine State College Experiment Station Report, 1895. Plate II.



The Currant Fly, Gooseberry Fruit-Fly.

(*Epochra Canadensis, Loew.*)

APPENDIX.

Bulletins Issued in 1895.

BULLETIN No. 17.

IMPORTANT FACTS ABOUT CORN.

Bulletin No. 11 of this Station treats of the relative yield of mature Maine Field Corn and immature Southern Corn.

The data collected during a study of this matter show certain allied facts that are of much importance to the farmer who is planning to produce corn the coming season as a fodder or silage crop.

COMPOSITION OF MATURE MAINE FIELD CORN AND IMMATURE SOUTHERN CORN.

Analyses of the experimental crops of corn on the College farm reveal the composition displayed below.

Crops of 1892 and 1893, average.	IN 100 POUNDS GREEN CORN.						
	Water —lbs.	Dry substance —lbs.	Ash—lbs.	Protein Nx6.25 —lbs.	Fiber--lbs.	Nitrogen free extract—lbs.	Fat—lbs.
Southern corn, immature	84.80	15.20	1.18	1.78	4.20	7.70	.34
Maine field corn, mature.	78.91	21.09	1.28	2.28	4.15	12.77	.61
Excess in field corn..........	-	5.89	.10	.50	—.05	5.07	.27

It appears from these averages that under the conditions existing in Maine, which require the cutting of the large varieties of corn in an immature state, the Maine field corn which reaches maturity, contains the larger percentage of dry matter. Again, the excess of dry matter in the Maine field corn consists almost wholly of the non-nitrogenous compounds classed under the head of nitrogen-free-extract.

The Maine Field Corn is in this case worth forty per cent. more than the immature Southern Corn, pound for pound, judging simply by the per cent. of dry matter. The great bulk of the Southern Corn fodder is not a proof of greater or even of equal value.

THE EFFECTS OF MATURITY UPON THE MAINE FIELD CORN IN COMPOSITION AND YIELD.

Composition: In order to obtain testimony on this point, in 1893 a field of Maine corn was cut in five different lots, ranging in times of cutting from August 15th to September 21st, and in stage of growth from the early formation of the ear to full maturity. The analyses of samples from these different cuttings appear below.

	IN 100 POUNDS GREEN CORN.						
	Water—lbs.	Dry substance—lbs.	Ash—lbs.	Protein Nx6.25—lbs.	Fiber—lbs.	Nitrogen free extract—lbs.	Fat—lbs.
Maine field corn, cut Aug 15.....	88.29	11.71	1.09	1.75	3.10	5.46	.30
Aug. 28.....	82.50	17.50	1.14	2.05	4.08	9.71	.52
Sept. 4......	80.45	19.55	1.21	2.23	3.85	11.68	.59
Sept. 12.....	76.83	23.17	1.29	2.22	4.48	14.50	.68
Sept. 21.....	74.66	25.34	1.50	2.34	4.71	16.04	.75

The immature and mature corn differ in the following essential particular:

The mature corn is less watery; i. e., it contains a much larger percentage of dry substance. During the thirty days before the mature crop was harvested there was a continuous and large increase in the percentage of dry matter. It will appear later that this was mostly due to an actual growth of dry matter, rather than to a drying out of water.

Yield: The field of corn selected for studying the influence of maturity upon the yield was of very uniform growth, being finely eared and in every way satisfactory for experimental purposes.

Each of the ten plots consisted of five rows, and it was decided to harvest one-fifth of the crop or one-tenth of an acre at each of five periods of growth, cutting one row of each plot at each period.

Date of cutting and condition of crop.	Days in each period of growth.	YIELD PER ACRE.		Gain in weight in each period, dry matter—lbs.	Rate of gain per day, dry matter —lbs.
		Green corn.	Dry substance.		
August 15, ears beginning to form........	....	26,166	3,064.0	....	....
August 28, a few roasting ears	13	29,777	5,210.9	2,146.9	165.0
September 4, all roasting ears	7	31,000	6,060.5	849.6	121.3
September 12, some ears glazing	8	28,833	6,680.6	620.1	77.5
September 21, all ears glazed	9	27,777	7,039.7	358.1	39.8
Increase dry matter after August 15 .	......	....	....	3,974.7	....

The results of this experiment certainly furnish a striking illustration of the folly of harvesting immature corn for silage or fodder purposes whenever it is possible to allow it to attain maturity.

In this instance, *the total quantity of dry matter in an acre of the corn at maturity was nearly two and one-half times greater than at the silking period thirty-seven days previous*, the average rate of increase of dry substance per acre being about 108 pounds daily. This daily increase is equivalent in quantity to one day's ration for four or five cows of ordinary weight.

THE INFLUENCE OF MATURITY UPON THE QUALITY OF THE DRY MATTER IN THE CORN PLANT.

It is well known that the portion of the plant known as nitrogen-free extract is a mixture of substances such as sugar, starch, gums, waxes, etc., some of which have a higher value than others for use by the animal. In short, the larger the proportion of starch and sugars in the nitrogen-free-extract of a food, the more highly do we estimate the nutritive worth of that food. For this reason a higher value is placed upon the nitrogen-free-extract of the grains than upon that of the coarse fodders.

It is evident then, that if allowing the corn plant to mature increases the relative proportion of sugars and starch in dry matter, we have not only the advantage of obtaining a larger yield of dry matter but we secure material of better quality for food purposes. The figures show the facts as obtained from a single investigation.

	Proportion of starch and sugars in Nitrogen-free extract.	Pounds of starch and sugars yielded per acre.
	%	lbs.
August 15, ears beginning to form	*25.1	*358.5
August 28, a few roasting ears	40.5	1,172.0
September 4, all roasting stage	42.7	1,545.0
September 12, some ears glazing	42.2	1,764.0
September 21, all ears glazed	50.3	2,244.0

* Probably somewhat too low.

It appears from the figures that not only is there a constant and large growth of starch and sugars up to the condition of maturity of the corn plant, *but these valuable compounds increase more rapidly than certain less important constituents, so that the mature plant substance is of better quality than at any previous stage of growth.*

SUMMARY.

(1.) Under the conditions existing in Maine the varieties of Flint Corn which mature in the state furnish fodder or silage material much more valuable, pound for pound of fresh weight, than it is possible to secure with the larger varieties of Dent Corn which do not mature.

(2.) The Flint varieties of corn should always be allowed to mature, as there is a large and continuous production of plant substance up to the period of full maturity. Harvesting half grown or immature corn is a wasteful practice.

(3.) Owing to the relatively large production of sugars and starch in the late stages of growth, a pound of the dry substance of the mature well-eared corn plant possesses a higher nutritive value than at any earlier stage of growth.

W. H. JORDAN.

MAINE STATE COLLEGE,
ORONO, ME., MARCH 1, 1895.

BULLETIN No. 18.**

INSPECTION OF FERTILIZERS, 1895.

W. H. JORDAN, Director.

J. M. BARTLETT, L. H. MERRILL, Chemists.

The Maine Legislature enacted at the session of 1893, a new law for the regulation of the sale and analysis of commercial fertilizers.

This change of law was sought in order to accomplish two objects:

1. The providing of funds that can be legally used, sufficient to pay the expenses of a proper inspection.

2. A provision whereby information as to the composition of the goods offered for sale can be given to the would-be purchaser at an earlier date than has heretofore been possible.

This law makes the following requirements upon manufacturers, importers or dealers who propose to sell or offer for sale their goods in the State. These briefly stated are:

1. Marking the bags properly.*

2. Filing annually a certificate with the director of the Station giving the manufacturer's or dealer's name, place of business, place of manufacture, name of brand of fertilizer and the guaranteed composition of the same.*

3. Depositing annually, unless excused by the director under certain conditions, a sample of fertilizer, with an accompanying affidavit that this sample "corresponds within reasonable limits to the fertilizer which it represents." These samples are designated in this bulletin as "manufacturer's samples."*

4. The annual payment of an analysis fee of fifteen dollars for every brand of complete fertilizer licensed.

5. All brands of which thirty tons or more are not sold are exempt from the last provision.

The law also imposes upon the Director of the Maine Agricultural Experiment Station certain duties which are:

1. The issuing of licenses to such manufacturers as comply with the above named requirements.

2. The analysis of the samples deposited by the manufacturers.

3. The selection of samples in the open market of all brands of fertilizers sold or offered for sale in the state, with the subsequent analysis of the samples.

4. The publication of bulletins or reports, giving the results of the inspection.

In accordance with the foregoing requirements, eighteen companies representing seventy-two brands of fertilizers have complied with

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** Given in part.

* Notice.—That requirements 1, 2 and 3 apply to all brands of fertilizers, whether thirty tons are sold or not.

the law, and the brands mentioned below can be sold legally in the state to the extent of thirty tons or more during the year 1895.

(The bulletin gave the manufacturer's guarantees and the analysis of manufacturer's samples, but as these figures are of only passing value they are omitted here. W. H. J.)

BULLETIN No. 19.

A DISCUSSION OF CERTAIN COMMERCIAL ARTICLES.

(1) FERTILIZERS.

A large sum of money is annually expended by Maine farmers for commercial fertilizers and commercial cattle foods. The trade in these articles offers, therefore, wide opportunities for the practice of fraud, and for the sale of various nostrums and mixtures at prices several times larger than the value to the purchaser of the goods delivered. Through credulity, lack of accurate knowledge and hasty judgments Maine farmers have suffered their fair share financially at the hands of plausible "agents." In too many instances the goods are first bought for cash or on credit, invariably at an unusually large price, and then after the act is past recalling, information is sought as to the character and value of the "fertilizer" or "food" purchased. If accurate information were first obtained in these cases there would be less of these transactions where value is not received for the money paid.

There are two claims which generally characterize the representations of the companies and agents selling these questionable goods:

(1) The process of manufacture is a secret one, having been "discovered" by some one who is generally unknown either to science or practice.

(2) The "fertilizer" or "food" either contains ingredients of which the whole world, outside of a favored few, is ignorant, or else certain ingredients are so wonderfully compounded as to produce marvelous results.

In all instances that have come under the writer's notice such materials have ingredients of some actual value for feeding plants and animals. Are the claims of extraordinary value well founded?

Let us examine some of the cases that have been investigated.

FERTILIZERS.

There is a case in hand just now which well illustrates the sale (attempted at least) of a fertilizer in accordance with claims that cannot be justified by existing knowledge, and at a price greatly out of proportion to the real value of the article.

Reference is made to the fertilizers offered for sale by The Chemical Compound Fertilizer Co., otherwise Mason, Chapin & Co., Providence, R. I.

From the published reports of this company and from the testimony of correspondents, concerning the price asked and the claims made by their agents, etc., we learn:

1st. The compounding of the fertilizers is a secret process. "The exact method in which this is accomplished is a secret of great value to us and which we do not propose to give away to the public."

2nd. The phosphoric acid is classed as "soluble in the soil," which to the chemist is an indefinite and suspicious form of statement.

3rd. No statements are made as to whether the fertilizers contain potash or not. They are advertised as containing certain percentages of "alkali," which may be interpreted as either potash or soda.

4th. Written testimony shows that the agent offering these fertilizers claims that 600 pounds of the form for potatoes would be found equal to a ton of the ordinary superphosphates.

5th. The fertilizers have been offered at the remarkable price of $55 per ton.

Fortunately for the farmers such new materials as the above are, in these days, very soon brought to the test of a severe investigation. Samples of these particular fertilizers have been examined at the Connecticut and Maine Experiment Stations, and the results of the analyses make these peculiar claims appear rather grotesque, and the price highly exorbitant. The following are the analyses:

	CONNECTICUT ANALYSES.			MAINE ANALYSES.	
	For potatoes—per cent.	For potatoes—%.	For corn—per cent.	For onions—per cent.	For potatoes—per cent.
Nitrogen in nitrates	4.03	3.56	1.47	3.43	3.42
Phosphoric acid soluble in water	.11	.22	.29	....	......
Phosphoric acid "reverted"	2.20	2.38	2.08	1.93	2.11
Phosphoric acid insoluble	11.51	10.08	13.70	13.00	9.48
Phosphoric acid total	13.82	12.68	16.07	14.93	11.59
Potash	....	....	....	.14	26
Valuation	$18 84	$17 23	$12 38	$17 73	$17 14
Selling price	50 00	50 00	50 00	....	55 00

An examination at the Connecticut Experiment Station still more exhaustive makes it evident that the fertilizers are made up by mixing nitrate of soda, some crude, ground phosphate and probably soda ash.

The comments by the Connecticut Experiment Station on these goods and on the lately much discussed value of soda as a substitute for potash, are so entirely clear and sound that they are reproduced here.

"A mixture of 500 pounds of nitrate of soda, costing $12.50, 1200 pounds of basic slag costing $11.40 and 300 pounds of dry carbonate of soda, costing $6.00, total cost $29.90, would contain approximately the same quantities of nitrogen, phosphoric acid and soda and would have at least as great a crop-producing power as these fertilizers costing $50.00 per ton ($55.00 in Maine.)

The only valuable fertilizing ingredients contained in these fertilizers, viz:, phosphoric acid could, however, be bought for not far from $20.00, so that the plant food in these goods costs more than twice as much as the farmer needs to pay for it.

It is claimed that the soda existing in these fertilizers as carbonate and nitrate is an efficient substitute for potash in the plant and in the soil. So far as the plant is concerned a large amount of the most refined investigation would appear to demonstrate conclusively that soda cannot in any sense or to any extent take the place of potash in plant-nutrition. Plants growing in presence of abundance of potash usually take up and contain more potash than they really need. This accidental or unnecessary potash may indeed be replaced by soda, but both may be withheld without detriment to the plant. Even the salt-worts and seaweed which usually grow in soils or water containing much sodium compounds, flourish equally as well in absence of soda,but cannot exist in default of potash.

On the other hand, soda may sometimes or often take the place of potash as a fertilizer. In such cases it operates indirectly, not by entering itself into the crop as a needful food to the plants, but by its action on the soil, making more rapidly available some other ingredient of the soil, it may be potash, or lime or nitrogen, which is there present, but exists in a comparatively inert state. It is well established that the use of soda as a fertilizer has often increased crops, but experience shows that it is commonly an uncertain and unsafe application to land. In any case it does not enrich the soil or increase its stores of plant food, but simply facilitates their solution, consumption, and it may easily be, their waste.

As a rule soils contain more soda than potash and the frequent use of soda in fertilizers tends to exhaust and impoverish the land. If soda is to be used it is most cheaply supplied in nitrate of soda, which by its nitrogen may easily return its entire cost, leaving its soda in the soil as carbonate, and if more alkali is useful, lime is vastly cheaper than soda and not a whit less efficacious, is in fact, what soda is not, an essential element of plant-nutrition, as well as the safest and surest means of fluxing the inert plant-food of the soil and putting its hoarded capital into active circulation."

Bulletin 20 will continue this discussion in the consideration of a certain class of cattle foods.

W. H. JORDAN.

MAINE STATE COLLEGE,
ORONO, ME., MARCH 15th, 1895.

BULLETIN No. 20.

A DISCUSSION OF CERTAIN COMMERCIAL ARTICLES.

(2) FOODS.

A class of materials commonly spoken of as "Condimental" or "patent" foods, has been found in our markets for many years. Now and then a new one appears, as has lately been the case in Maine. These foods are generally given some pretentious name such as "Condimental Cattle Food," "Imperial Egg Food," "Nutriotone," etc. They usually possess an aromatic or other positive odor, which to the uninitiated gives the appearance of value.

The claims that are made for the nutrient and tonic properties of these commodities are fairly startling as lying outside the range of either common experience or scientific knowledge, and on the strength of such claims these wonderful mixtures are sold in most cases at prices ranging from $100 to $2,000 per ton. How utterly absurd both the claims and the prices appear in the light of facts! Repeated careful examinations of these materials show that *without exception they consist principally of common cattle foods, or other common materials, mixed with small percentages of the cheapest and most ordinary medicinal substances.*

The following are the results of a number of examinations made by various experiment stations:

From Rep. Conn. Expt. Sta., 1878, p. 125.

"Condimental Cattle Food," cost $8.00 per 100 pounds. "It consists chiefly of corn meal and bran. It contains enough fenugreek to give it a strong flavor of that aromatic seed and likewise some seeds like caraway in appearance . . . ."

From Rep. Maine Exp. Sta., 1885, p. 52.

"Imperial Egg Food." Cost 50 cents per pound. Chiefly clam and oyster shells with some bone, also some pepper.

Johnson's Continental Food. Cost 75 cents for 10 pounds. "A mechanical examination shows that the food is undoubtedly wheat bran with possibly some middlings." Contains "some fenugreek" and "a little sulphur."

"English Patent Food." Cost $1.00 for a bag of 12 pounds. "Appears to be made up of middlings and corn meal, largely middlings. . . ." Contains "some fenugreek."

From Bulletin No. 20. Mass. Expt. Sta., p. 6.

"The Concentrated Feed." Cost $8.00 per 100 pounds. ". . . A mixture of several ingredients, among them was noticeable common salt."

From Rep. Conn. Expt. Sta. 1888, p. 146.

"The Concentrated Feed for Horses, Cattle, Sheep, Swine, Poultry, etc." "Apparently consists of a mixture of wheat and corn with thirteen per cent. of salt and perhaps a little of some more concentrated food." "Costs $100 per ton in three ton lots, ... $160 per ton in small quantities."

"The Concentrated Egg Producer." Cost $4.00 for 12 pounds, equivalent to $660 per ton. Contains both corn and wheat and some more concentrated food."

From Bulletin 15, N. H. Expt. Sta.

"Pratt's Food." Cost 75 cents for 12 pounds or $6.00 per 100 pounds. The food appears to be wheat middlings to which has been added some fenugreek and common salt."

"Weston's Condition Powder." Cost 50 cents for package of three pounds. "It resembled a mixture of corn meal and cotton seed meal and it had a saline taste and strong odor of fenugreek."

"Climax Food." Cost $1.00 per 12 pounds or $8.00 per 100 pounds. "It resembled a mixture of fine wheat middlings and wheat screenings together with a small quantity of caraway or fenugreek seeds and small bits of a substance like butter-nut or elm bark," also common salt 9.77 per cent., Glauber's salt, 4.50 per cent., and Chili Saltpeter 3.84 per cent.

From Rep. Maine Exp. Sta., 1892, p. 26.

"Pratt's Food." Cost $120 per ton. "Has the appearance of being chiefly ground bran or shorts. Contains a small amount fenugreek." . . . . "Contains something less than three per cent. of common salt."

From Rep. Conn. Expt. Sta. 1893, p. 244.

"Nutriotone." "It contains a considerable quantity of some leguminous seed, some linseed meal and perhaps other feeding stuffs together with aromatic substances (fenugreek, anise seed, caraway and the like,) and over ten per cent. of salt."

"Silver Live Stock Powder." Cost $1.00 per pound. "Consists essentially of ground bone having a dark color and slight odor of coal tar."

From Crop Bulletin No. 6, 1894, Me. Board of Agr.

"Nutriotone." Cost 25 cents per pound. (Sold in some cases for $7.00 for 50 pounds.) "Consisted largely of linseed meal with a litle fenugreek and apparently some pea or bean meal. It contained 18.67 per cent. ash, a large part of which was common salt."

The following are some of the statements that have been made by men who are students of animal nutrition, in regard to condimental cattle foods in general.

"Mr. Lawes of Rothamstead, England, made a most thorough, practical trial on the use of condiments in feeding, and demonstrated that there is no profit in it."—*Rep. Conn. Expt. Sta.. 1878, p. 125.*

"The foods have no greater nutritive value than wheat bran, middlings and corn meal from which they are made, while the small quantities of fenugreek and sulphur are utterly valueless to a well animal, and a poor reliance as a means of curing a sick one."—*Rep. Maine Expt. Sta., 1885, p. 53.*

"The practice of buying *compound* feeding stuffs in the general market, without a sufficient *actual* knowledge regarding the kind or the character of its various ingredients, ought to be decidedly discouraged; for the farmer who pursues that course, leaves his best interest to mere chance."—*Mass. Expt. Sta., Bul. 20, p. 7.*

"It has been abundantly proven that condimental foods have no advantage over others by reason of the condiments in them. As medicines they may well be distrusted in view of the absurd claims made by the seller."—*Rep. Conn. Expt. Sta., 1888, p. 148.*

"Quack horse doctors and Concentrated Cattle food manufacturers are twins, and they flourish, not on the ignorance of farmers, but on that lingering remnant of old times, which made saltpeter and sulphur the universal cure-all for horses and cattle. .... The foods reported below are worth only from $20 to $25, per ton. ...... So far as the medicinal claim is concerned, ... even the treatment of a 'Quack' is better, and certainly cheaper, than the wholesale use of mixtures of unknown composition."—*Bul. 15, N. H. Expt. Sta., p. 3.*

FACTS TO BE REMEMBERED.

(1) The mixture of ingredients contained in the ordinary foods comprises all that are known either to practice or science as useful to animal life.

(2) The ordinary cattle foods supply animal nutrition in the most useful and economical forms.

(3) Condimental foods are absurd as medicines. If an animal is well no medicine is needed, if ill, remedies adapted to the case should be administered.

(4) The farmer could manufacture his own "condimental" foods at a fraction of their usual cost, by mixing a small amount of such common sustances as salt, sulphur, saltpeter, fenugreek, caraway, &c., with the daily grain ration.

W. H. JORDAN.

MAINE STATE COLLEGE,
ORONO, ME., MARCH 25, 1895.

BULLETIN No. 21.

NOTES ON SMALL FRUITS.

The progress made in the culture of small fruits during the past twenty years has been rapid and substantial, but even at the present time the importance of this branch of horticultural work is not fully recognized by the people of the State. From the very nature of the soil and climate of Maine we must look to intensive rather than to extensive operations for the most profitable returns. At the present time there is no line of work which seems more promising than that of the culture of small fruits. With the increasing importance of our summer resorts, new and extensive markets are opened; while the operatives in the factories are always large consumers of fruit.

The purpose of this Bulletin and of succeeding ones is to give brief, concise hints on the culture of small fruits and information concerning some of the more important varieties.

The essential elements of success in small fruit growing are: suitable location; thorough preparation; the best varieties; careful planting; thorough culture; the application of business principles in marketing.

THE STRAWBERRY.

A warm, rather moist sandy loam is usually preferred in growing this fruit, but in general any soil that will raise a good crop of corn will raise good strawberries. I would not be understood as encouraging neglect in any way, but the minute directions sometimes given for preparing the soil and for planting are misleading and are enough to discourage any novice from attempting to grow fruit.

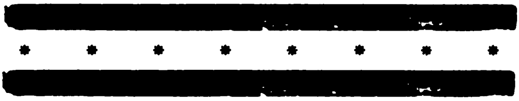
Thorough drainage, either natural or artificial, is absolutely essential, and thoroughness in the preparation of the soil is of prime importance, but the excessive applications of manure and the hand labor frequently advised are unnecessary. It is well to grow some hoed crop as corn or potatoes on the land for one or two years before setting the plants, as in this way there is less danger from attacks of the "white grub."

The month of May is, perhaps, the best time for setting strawberry plants in this latitude, though good results often follow fall setting. Two very important considerations in setting the plants are that the crowns be just even with the surface of the earth and that the soil be pressed firmly about the roots. These points cannot be too strongly emphasized, for to their disregard may be traced more than half the failures in starting new plantings.

For general field culture the "matted row" system is probably best. The rows should be as long as convenient, that most of the labor of cultivating may be performed with a horse. The plants should be set eighteen inches apart in rows which are about four feet apart. Thus placed, a little more than seven thousand plants will be required for an acre. During the first season thorough culture should be practiced. It is also well to keep the runners cut back till the parent plants are strong and well developed.

Winter protection of the plants is always advisable. The value of such treatment is two fold: Not only are the plants protected from injury, but the fruit is kept clean and bright. The best material for the purpose is coarse meadow hay cut before the seeds have ripened. We have sometimes used "shingle edgings" with very satisfactory results. In the vicinity of large mills this material may often be obtained much more cheaply than the hay.

On light gravelly soils we have sometimes resorted to the use of boards on each side of the row of plants as illustrated below:



This device is found a very satisfactory means of conserving moisture and will permit the growth of plants in locations which would otherwise be unsuitable. Naturally this device is recommended only for the home garden.

The question of varieties, although of great importance, is one which must be settled largely by individual growers; for the success of any variety will frequently depend on local conditions. It is always a good plan to have a trial ground for the newer sorts, as varieties of much promise at the Experiment Station may prove worthless in some localities.

In selecting varieties for planting it is well to bear in mind the distinction between the perfect flowering and the pistillate sorts. Many of our most valuable sorts are pistillate and must have some perfect flowering variety interspersed in order to secure the best results.

The following notes represent our estimate of the varieties fruited at the Experiment Station during the past two years:

Beeder Wood. (Perfect).—Small, spherical, uniform in size early in the season but soon "runs out." One of the earliest and most prolific sorts but of inferior quality. Plants quite subject to rust.

Beverly. (Perfect).—Large, oblong or spherical; of a rich dark color, moderately good quality, firm, prolific. A promising variety.

Bubach. (Pistillate).—Very large, irregular; of good color but poor quality, and lacking in firmness. Productive; valuable for near markets.

Charles Downing. (Perfect).—Of medium size, nearly spherical, moderately firm and of good quality. An old favorite for home use, but not as prolific as some others. Quite subject to rust.

Crawford. (Perfect).—Large, nearly spherical,uniform and regular; productive and of good flavor, but too soft and too light colored for market.

Crescent. (Pistillate).—An old and deservedly popular sort; but rather small and not of high quality.

Cumberland. (Perfect).—Plants vigorous and prolific; fruits large and of good quality, but too light colored and soft for market. One of the best for home use.

Dayton. (Perfect).—Medium to large, smooth and regular; of good quality but light colored and soft. Excellent for home use but too soft for market.

Epping. (Perfect).—Plants vigorous and prolific; fruit of medium size, roundish conical, uniform, bright red. A promising variety, received for trial from George Q. Dow, North Epping,N. H., under the name of "Yankee Doodle."

Gandy. (Perfect).—Of medium size, uniform, regular, firm and of good quality. Usually regarded as of special value as a late variety, but has not held its own with us.

Gen. Putnam. (Pistillate.)—Of medium size, but of pale color, soft and inferior in every way.

Gillespie. (Perfect).—Medium to large,oblong or conical,often with pronounced neck, firm, of good quality and color. One of the best sorts for general purposes.

Greenville. (Pistillate).—Medium to large, roundish conical, uniform, bright red, moderately firm and of good quality. Good for home and near market.

Haverland. (Pistillate).--Medium to large, oblong, regular, firm and of good quality. Plants strong and vigorous; free from rust. A very good sort for general purposes.

Jessie. (Perfect).—An early sweet berry of good size. Oblong or conical, bright glossy red, handsome and of good quality. It has been one of the most satisfactory with us but is not uniformly reliable.

Jewell. (Pistillate).—Of medium size and uniform; but soft and of light color. Not prolific.

Leader. (Perfect).—Medium size, roundish, bright red; fairly good quality. Only moderately productive.

Lovett. (Perfect).--Of the Crescent type. Early, prolific, but running small as the season advances and of second quality.

Michel's Early. (Perfect).—The earliest berry we have grown. Very productive, but small and of second quality. Blossoms very early and the flower trusses are short and well protected. Plants only moderately vigorous.

Mount Vernon. (Perfect).—Medium size, roundish conical, uniform. Of no special value.

Parker Earle. (Perfect).—Very productive, of large elongated fruit having a pronounced neck; firm and of good quality. The plants are very strong and vigorous, but send out few runners, hence should be planted thickly in the row. A valuable sort.

Princess. (Pistillate).—Plant strong, vigorous and productive; fruit a little dull in color, but large, nearly spherical, uniform, moderately firm and of good quality. Medium to late in season. One of the best general purpose sorts.

Sharpless. (Perfect).—Plants vigorous and prolific. Fruit large but somewhat irregular and not always ripening evenly. Of good quality and always reliable.

Smeltzer. (Smeltzer's Early). (Perfect).—Sent for trial by F. H. Smeltzer, Van Buren, Ark. Plants vigorous, healthy and productive. Fruit uniformly of medium size, oblong, firm, of dark rich color and good quality. A promising early variety.

Swindle. (Pistillate).—As grown on our grounds the variety is rightly named. Plants strong and vigorous but not productive. Fruit of medium size, light colored and of very poor quality.

Van Deman. (Perfect).—An early variety; small, spherical; of rich dark color and good quality, but soft and not productive.

Warfield. (Pistillate or with abortive stamens).—Moderately vigorous. Flowers small on short truss and well protected by foliage. Fruit of medium size, firm texture, moderately good quality; ripens evenly, holds its size through the season. Its deep rich color and productive habit make it one of the most valuable market sorts.

West Lawn. (Pistillate).--Sent for trial by C. P. Bauer & Bro., Judsonia, Ark. Plants very vigorous but not productive. Similar in general characteristics to "Cloud," which was sent out a few years ago.

The best of the older varieties above named are: Bubach, Crescent, Haverland, Sharpless and Warfield, with possibly Beeder Wood or Michel's as very early perfect flowering sorts.

Of the newer varieties the following deserve special mention: Beverly, Dayton, Epping, Gillespie, Greenville, Parker Earle, Princess, Smeltzer.

W. M. MUNSON.

MAINE STATE COLLEGE,
ORONO, ME., April 15, 1895.

BULLETIN No. 22.

INSPECTION OF FERTILIZERS.

W. H. JORDAN, Director.

J. M. BARTLETT, L. H. MERRILL, Chemists.

This bulletin is the second to be issued during the year 1895 giving a report of the official inspection of fertilizers. The first bulletin, No. 18, was published on March 9th, and gave the results of the analyses of Manufacturer's Samples. These samples were furnished by the manufacturers for inspection accompanied by an affidavit that they were like the goods which they represented "within reasonable limits."

The samples mentioned in this bulletin are almost wholly those selected by a Station representative at different points in the State from goods which were exposed or offered for sale. These samples were very carefully taken in accordance with the provisions of a law which seeks to guard the rights of the manufacturers, and they certainly represent the particular lots of goods from which they were selected.

The main purpose of selecting samples from the various brands of fertilizers as found in the open market is to ascertain if the goods actually on sale meet the requirements of the manufacturer's guarantees, and whether the manufacturer's samples, whose analyses are published in the Spring bulletin, are to any extent a safe guide in the purchase of fertilizers.

The comparison which follows shows very plainly what are the facts. It may be said that on the whole it appears that the manufacturers intend to deal fairly with the public in the matter of their guarantees, remembering always, of course, that no manufacturer can be held to have guaranteed more than the minimum percentage in which any ingredient is stated to be present.

Notwithstanding certain sarcastic, and we can but believe, unfriendly criticisms, because this Experiment Station decided to drop the system of commercial valuations, there is no present intention of receding from that decision. There are already indications that farmers who are disposed to put intelligence into their business will themselves, through the information furnished by the Station, make such calculations as are necessary for their choice of the brand which they can most economically purchase and will in that way understand the situation as they could in no other way; and it is obvious that to those farmers who are so careless or uninformed as not to do this, the valuations made by the Station are likely to be nothing but a stumbling block.

Any system of aiding the farmer which is merely mechanical and which leaves out of account a proper study on his part of the facts with which he has to deal is false in theory and less helpful in practice than it should be.

(The bulletin gave the manufacturers guarantees and the analyses of manufacturer's samples, but as these figures have only a passing value they are omitted here. The comments on the results of the inspection follow, however. W. H. J.)

A comparison is made of the samples selected by a Station representative, the manufacturer's samples and the minimum guarantees. The important considerations are the following:

(1.) Fifty-seven brands are involved in this comparison.

(2.) The averages for nitrogen are: Guarantee, 1.99 per cent., manufacturer's sample, 2.14 per cent., Station sample, 2.09 per cent. For available phosphoric acid the averages are: Guarantee, 7.84 per cent., manufacturer's sample, 9.05 per cent., Station sample, 8.58 per cent. For potash: Guarantee, 3.31 per cent., manufacturer's sample, 3.60 per cent., Station sample, 3.42 per cent.

(3.) In the fifty-seven brands, the Station sample as compared with the manufacturer's sample was, in nitrogen practically the same twenty-three times, poorer twenty-two times and better twelve times; in available phosphoric acid, practically the same fourteen times, poorer thirty-one times and better twelve times; in potash, practically the same sixteen times, poorer twenty-four times and better seventeen times.

(4.) Comparing the *Station sample* with the *minimum guarantee*, the Station sample was, in nitrogen, practically the same twenty-seven times, poorer nine times, better twenty-one times; in available phosphoric acid, practically the same twenty times, poorer seven times, better thirty times; in potash, practically the same seventeen times, poorer fourteen times, and better twenty-six times.

It is quite customary for manufacturers to state a minimum and a maximum guarantee for the percentages of the ingredients of their goods, as for instance the guarantee for available phosphoric acid would be eight to ten per cent. The above comparisons indicate that the manufacturers do not intend to do much more than make good the minimum guarantee, and that this is all the purchaser can safely expect.

It is gratifying to note that as a rule the fertilizers sold in the State are well up to this guarantee. Indeed, there is no case which appears to be an attempt to defraud, although in a few instances the particular lots of goods sampled are not quite as good as they should be.

MAINE STATE COLLEGE,
Orono, Me., 1895.

FERTILIZER LAW IN FORCE IN MAINE.

PUBLIC LAWS OF MAINE, 1893.

CHAPTER 256.

AN ACT to regulate the sale and analysis of Commercial Fertilizers.

SECTION 1. Every manufacturer, company or person who shall sell, offer or expose for sale in this state any commercial fertilizer or any material used for fertilizing purposes, the price of which exceeds ten dollars per ton, shall affix to every package of such fertilizer in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in the package sold or offered for sale, the name or trade mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business and a chemical analysis stating the percentage of nitrogen, or its equivalent in ammonia in available form, of potash soluble in water, and of phosphoric acid in available form, soluble and reverted as well as the total phosphoric acid.

SECT. 2. Every manufacturer, company or person who shall sell, offer or expose for sale in this state any commercial fertilizer or material used for fertilizing purposes, the price of which exceeds ten dollars per ton, shall for each and every fertilizer bearing a distinguishing name or trade mark, file annually with the director of the Maine Agricultural Experiment Station, between the fifteenth day of November and the fifteenth day of December, a certified copy of the statement, named in section one of this act, said certified copy to be accompanied, when required, by a sealed glass jar or bottle containing at least one pound of the fertilizer to be sold or offered for sale, and the company or person filing said certified copy with its accompanying sample of fertilizer shall thereupon make affidavit that said sample corresponds within reasonable limits to the fertilizer which it represents in the percentage of nitrogen, total and available phosphoric acid, and potash soluble in water which it contains. Such affidavit shall apply to the entire calendar year next succeeding the date upon which said affidavit is made, unless the person or persons making such affidavit shall give notice to the director of the Maine Experiment Station that a change is to be made during the year in the percentages of the above named ingredients contained in the fertilizer, in which case he shall, before selling or offering for sale such fertilizer, file another certified statement with an accompanying sample of fertilizer and an affidavit as hereinbefore required. The deposit of a sample of fertilizer as herein provided shall be required by said director unless the company, manufacturer or person selling or offering for sale a fertilizer coming within the provisions of this act, shall certify that its composition for the succeeding year is to be the same as given in the last previously certified statement, in which case the requiring of said sample shall be at the discretion of said director.

SECT. 3. The director of the Maine Experiment Station shall analyze, or cause to be analyzed, all the samples of fertilizers which come into his possession under the provisions of section two of this act, and shall publish the results thereof in a bulletin or report on or before the fifteenth of March next succeeding.

SECT. 4. Any manufacturer, importer, agent or seller of any commercial fertilizer, who shall deposit with the director of the Maine Experiment Station a sample or samples of fertilizer under the provisions of section two of this act, shall pay annually to said director an analysis fee as follws: Ten dollars for the phosphoric acid and five dollars each for the nitrogen and potash, contained or said to be contained in the fertilizer, this fee to be assessed on any brand of which thirty tons or more are sold in the state, and upon receipt of such fee and of the certified statement named in section two of this act, said director shall issue a certificate of compliance with this act. Whenever the manufacturer or importer of a fertilizer shall have filed the statement made in section two of this act and paid the analysis fee, no agent or seller of said manufacturer, importer or shipper shall be required to file such statement or pay such fee. The analysis fees received by said director shall be paid immediately by him into the treasury of said experiment station.

SECT. 5. Any manufacturer, importer or person who shall sell, offer or expose for sale in this state any commercial fertilizer without complying with the requirements of sections one, two and four of this act, or any fertilizer which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined one hundred dollars for the first offence, and two hundred dollars for each subsequent offence.

SECT. 6. The director of the Maine Experiment Station shall annually analyze, or caused to be analyzed, at least one sample, to be taken in the manner hereinafter presribed, of every fertilizer sold or offered for sale under the provisions of this act. Said director is hereby authorized and directed in person or by deputy to take a sample, not exceeding two pounds in weight, for said analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer in this state; but said sample shall be drawn in the presence of said party or parties in interest, or their representative, and taken from a parcel or a number of packages which shall not be less than ten per cent. of the whole lot sampled, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representative at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled; and the sample or samples retained by the director shall be for comparison with the certified statement named in section two of this act. The result of the analysis of the sample or samples so procured shall be published in a report or bulletin within reasonable time.

SECT. 7. Whenever the director becomes cognizant of the violation of any of the provisions of this act he shall report such violation to the secretary of the board of agriculture, and said secretary shall prosecute the party or parties thus reported; but it shall be the duty of said secretary upon thus ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of any fertilizer or fertilizing material if the same shall be found substantially equivalent to the certified statement named in section two of this act.

SECT. 8. All acts and parts of acts inconsistent with this act are hereby repealed.

SECT. 9. This act shall take effect when approved.

Approved March 14.

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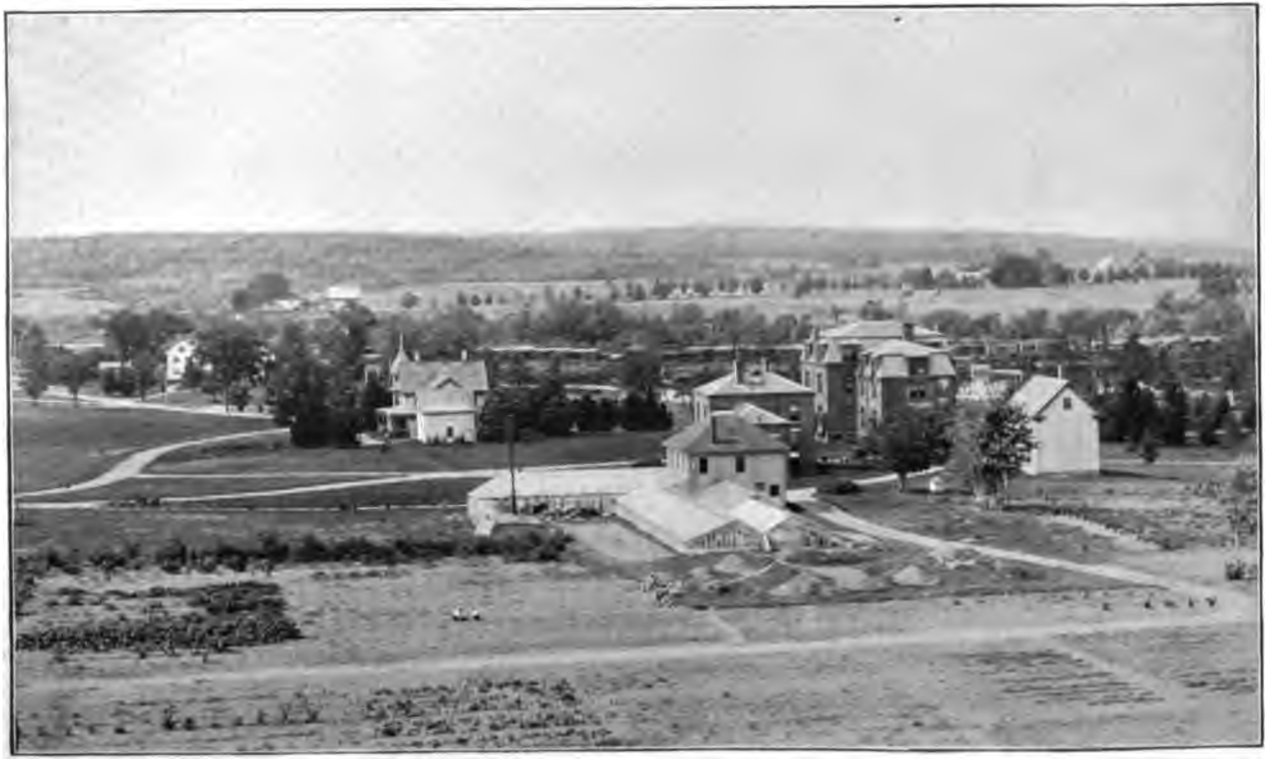

GREEN HOUSES AND OFFICES.

TWELFTH ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE

1896

Part II of the Annual Report of the Maine State College.

AUGUSTA
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1897

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The Station

The Bulletins of this Station will be sent free to any address in Maine. All requests should be sent to

Maine Agricultural Experiment Station,
Orono, Maine.

STATE OF MAINE

A. W. Harris, Sc. D., President Maine State College:

SIR:—I transmit herewith the Twelfth Annual Report of the Maine Agricultural Experiment Station for the year ending December 31, 1896.

CHARLES D. WOODS,
Director.

ORONO, Maine, December 31, 1896.

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MAINE AGRICULTURAL EXPERIMENT STATION.

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THE STATION STAFF.

THE PRESIDENT OF THE COLLEGE.

CHARLES D. WOODS,	Director
JAMES M. BARTLETT,	Chemist
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ORA W. KNIGHT,	Assistant Chemist
LUCIUS J. SHEPARD,	Assistant Horticulturist
MRS. J. HAMLIN WAITE,	Stenographer

REPORT OF THE TREASURER.

Maine Agricultural Experiment Station in account with the United States appropriation, 1895-6:

Dr.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1896, as per act of Congress approved March 2, 1887		$15,000 00

Cr.

By salaries:		
(a) Director and administration officers	$2,150 00	
(b) Scientific staff	4,888 98	
(c) Assistant to scientific staff	2,074 18	
(d) Special and temporary services	227 32	
Total		$9,340 48
Labor:		
(a) Monthly employees	$128 71	
(b) Daily employees	217 54	
(c) Hourly employees	368 12	
Total		714 37
Publications:		
(a) For printing	$349 70	
(c) For envelopes for bulletins and reports	30 00	
(d) Other expenses	19 50	
Total		399 20
Postage and stationery		139 01
Freight and express		204 61
Heat, light and water		381 98
Chemical supplies:		
(a) Chemicals	$120 72	
(b) Other supplies	105 02	
Total		225 74
Seeds, plants, and sundry supplies:		
(a) Agricultural	56 82	
(b) Horticultural	178 91	
(c) Botanical	58 77	
(d) Entomological	1 48	
(e) Miscellaneous	5 25	
Total		301 23

Fertilizers		$32 70
Feeding stuffs		340 67
Library		156 00
Tools, implements, and machinery		35 17
Furniture and fixtures		391 33
Scientific apparatus		886 40
Live stock:		
(b) Cattle	$640 00	
(d) Swine	10 00	
Total		650 00
Traveling expenses:		
(a) In supervision of Station work	$134 84	
(b) In attending various meetings	43 50	
Total		178 34
Contingent expenses		233 23
Building and repairs:		
(a) New buildings	$154 61	
(b) Improvements	88 74	
(c) Repairs	276 11	
Total		519 46
Total		$15,000 00

ISAIAH K. STETSON, Treasurer.

I, the undersigned, duly appointed Auditor of the Corporation, do hereby certify that I have examined the books of the Maine Agricultural Experiment Station for the fiscal year ending June 30, 1896; that I have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000.00, and the corresponding disbursements, $15,000.00; for all of which proper vouchers are on file and have been examined by me and found correct.

And I further certify that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

ELLIOTT WOOD, Auditor.

REPORT OF THE DIRECTOR.

Chas. D. Woods.

The work of the first half of the year was conducted under the direction of Professor Jordan. With the change of director which took place July 1, 1896, there was little change in the policy of the Station. Its principal lines of work have been the same as in former years and are briefly referred to in the pages which immediately follow. A more detailed report of the work of the Station during the year is given by my associates in the pages beyond.

The Director wishes here to express his appreciation of the kind reception given to him and the loyal co-operation of his associates in prosecuting the work of the Station.

CHANGES OF STATION STAFF.

There have been a number of changes in the station staff during the year. The following concerning the change of director is taken from the report of the President of the College to the Trustees.

"Professor Whitman Howard Jordan, Sc. D., Director of the Experiment Station, resigned his position July 1, 1896, to accept the directorship of the State Experiment Station of New York. It was a matter of sincere regret that we were unable to retain him, but the opportunities and salary offered him in New York were so much greater than he enjoyed here that he could not be expected to stay with us without changes which would cause an increase of our expenses beyond our means. He was a graduate of the college in the class of 1895. After spending some time in the Experiment Station at Middletown, Conn., the first in the United States, and then recently established, he returned to the college as instructor. He served as professor of agriculture for some years in the Pennsylvania State College, and again returned to Orono as director of the Experiment Station."

"Professor Charles Dayton Woods, B. S., who succeeds Professor Jordan, comes to us from the Storrs (Conn.) Experiment Station, of which he was assistant director. He is a graduate of Wesleyan University, and has studied abroad. He was one of the early workers in the first experiment station in the United States. He holds a commission from the United States Government for investigations on human foods."

After a year's leave of absence which was spent in study abroad and at Cornell University, Professor Munson returned to his duties at the Experiment Station, July 1, 1896.

Mr. Fred C. Moulton, M. S., assistant chemist, resigned August 31st. Mr. Henry B. Slade, A. B., a graduate of Brown University, is his successor.

Mr. Harris Perley Gould, B. S., assistant horticulturist, resigned his position August 31, in order to pursue post-graduate studies elsewhere. He has been succeeded by Mr. Lucius Jerry Shepard, B. S., a graduate of the Massachusetts Agricultural College.

Mr. Ora W. Knight, B. S., a graduate of the College, was appointed assistant chemist December 1st.

Mr. A. M. Shaw, foreman of the farm, resigned December 31, 1896.

Professor G. M. Gowell, M. S., has been appointed agriculturist. This appointment will take effect January 1, 1897.

FERTILIZER INSPECTION.

The number of brands of fertilizers sold in the State seems to be steadily on the increase. Old companies are increasing the number of brands they are offering and new companies are entering the State. In 1894 the Station agent collected 60 brands; in 1895 he collected 74; in 1896 the number was 117, and the indications are that the number of brands sold in 1897 will come well up to 150.

Seventy-seven of the 117 brands sold in the State in 1896 were licensed; the remaining 40, according to the representations of the manufacturers, were exempted from the payment of the analysis fee as coming within the thirty ton limit. The terms of the law require, however, that these non-paying brands shall be inspected, consequently it is possible for a manufacturer, by selling a small amount of a large number of brands, to increase the work of inspection entirely out of proportion to the analysis fees paid.

As the cost of the fertilizer inspection must be borne entirely by the receipts from license fees, the inspection of the non-paying brands restricts the proper inspection of the regularly licensed brands. To correct this evil the Station Council proposes to ask the legislature of 1897 to so amend the law that the analysis fee shall apply to every brand sold in the State.*

INSPECTION OF CHEMICAL GLASSWARE USED IN CREAMERIES.

Nearly all the glassware that has been examined during the year has come from dealers in dairy supplies. It is reasonable to suppose, therefore, that the butter factories have renewed their stock by purchasing tested bottles and pipettes direct from the dealers and are complying with the law in that respect.

It has been gratifying to note that a very small percentage of the goods inspected the past year was inaccurately graduated.

During the year 1896 there were received and calibrated 801 cream bottles, 280 milk bottles, and 70 pipettes. Of this large amount of glassware only one cream bottle and five pipettes were found to be sufficiently inaccurate to throw them out. All the milk bottles were correct. The Station has adopted a new stamp, and bottles and pipettes found correct are now marked M. E. S.

The text of the law is printed in another place in this report.

NUTRITION OF PLANTS AND ANIMALS.

The box experiments for the purpose of determining the "foraging power" of certain plants for phosphoric acid have been continued. The results obtained up to the spring of 1896 were published in the report of this Station for 1895.

Field experiments on the growth of forage plants and the effects of fertilizers have been continued along the lines of other years. So far as results of value have been obtained they are given beyond.

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*This change was secured by act of legislature and approved by the governor February 24, 1897.

Several feeding experiments with milch cows have been made during the year. The results are reported by Mr. Bartlett in another part of this report.

Digestion experiments with sheep are in progress but are not completed. It is expected that these results will be printed in the report for 1897.

These experiments, involving as they do a great deal of chemical work, are time-consuming in their details, and a not inconsiderable portion of the time of the Station chemists has been given to their carrying out.

INVESTIGATION OF THE NUTRITION OF MAN.

The investigation of the nutrition of man, begun three years ago by the United States Department of Agriculture under a special act of Congress, was placed in the immediate charge of Professor W. O. Atwater of Wesleyan University, Middletown, Conn. The director of this Station was then associated with Professor Atwater and shared in the planning and carrying out of these investigations. On coming to this Station, his commission in the United States Department of Agriculture was continued and he still has an active part in this work.

The study of cereal foods, including experiments in digestibility and metabolism, which are in progress at several experiment stations and colleges, is under the immediate care of the director of this Station. The work at the Maine Station in the study of human food during the year has been chiefly on the digestibility of breads made from entire wheat flour, graham flour, and ordinary bread flour. These experiments are not finished. They involve, in addition to the study of the nutrients, the estimation of the fuel values of the foods and of the undigested residues. The metabolism of matter forms an important part of the investigation. These results will be published in bulletins of the Department of Agriculture. Abstracts of these bulletins giving the results will be printed in later reports of this Station. The present report contains an account of studies made by this Station in 1895.

INVESTIGATIONS WITH THE BOMB CALORIMETER.

The study of the fuel value of cattle food and of the food of man gives very valuable information. The chief uses of food are to build tissue, and to furnish the energy requisite for muscular and other work, and for the maintenance of the body heat. The power of food to supply force to do work and maintain temperature can be measured in terms of potential energy. To do this an apparatus called a calorimeter (heat measure) is used. A new form of bomb calorimeter developed by Professor W. O. Atwater and the director of this Station is described in the report of the Storrs (Conn.) Experiment Station for 1894, pages 135-151. Mr. O. S. Blakeslee, mechanician of the Wesleyan University, has made a bomb calorimeter for this Station. Investigations upon the fuel value of foods and the undigested residues of digestion experiments are in progress. Other studies with the bomb calorimeter are planned.

BOTANY.

The work in botany has been continued much as in previous years. The chief work of investigation is along the lines of (1) the diseases of plants and their remedies; (2) the introduction and distribution of weeds in the State; and (3) the life history of plants in relation to remedial measures. Considerable study of the quality of seeds and their contamination with weed seeds has been made.

ENTOMOLOGY.

The work in entomology is along the same lines as that of other years. It consists of (1) the study of the life history of insects doing injury in the State, so as to learn their most vulnerable points and suggest rational remedies; (2) the study of the insects of Maine as to kinds, distribution and variation from year to year, due to climatic changes, food supply and natural enemies; (3) the preparation of specimens for the cabinet to be used in identifying other specimens readily; and (4) preparations of specimens showing the stages in the life history and work of injurious insects.

THE WORK IN HORTICULTURE.

The work in horticulture has been similar to that of previous years. Studies in plant breeding continue as the most important of the lines of inquiry. This work includes a consideration of plants as affected by different conditions of soil, climate and culture, the effects of crossing and of heredity, as well as the improvement of promising wild types. In the forcing houses the study of the tomato has been continued and the culture of other fruits and vegetables, as the currant, radish and lettuce has received attention.

The small fruit plantation has been extended and the different varieties are coming into bearing. Many of the fruits sent to Aroostook county are beginning to bear. Some of the field notes made by the Horticulturist concerning these are given in another part of this report. Experiments on the propagation and culture of the blueberry from selected wild stock are in progress.

Spraying experiments for apple scab have been continued. The season of 1896 was unfavorable for the growth of scab and the results of the experiments are reserved till further trials have been made.

TUBERCULOSIS IN COWS.

Realizing the importance of a better understanding of this disease, the Station has during the year devoted a good deal of attention to the study of bovine tuberculosis. An affected herd of ten animals has been kept isolated from all other animals under as good hygienic conditions as possible. A small barn, 28x40 feet, was erected for their accommodation. The points being studied are: (1) the progress of the disease in affected animals; (2) the conditions under which tuberculin will cause a rise of temperature in tuberculous animals; and (3) the effect of good hygienic conditions on the progress and outcome of the disease. The work is still in progress and other phases of the disease will be taken up. A report of progress is given by Dr. Russell in another part of this report.

THE FARM.

Since the reorganization of the Station in 1888 it has used one of the college barns and has had under cultivation for experimental and other purposes about fifty acres of the college farm.

The oversight of all the work of instruction and investigation of the Department of Agriculture, with the exception of the college farm, is under the charge of one man in either his capacity as Professor of Agriculture or Director of the Station. It was thought that the best interests of the College in its relation to agriculture would be served by having all of the agricultural work of the College consolidated. This will be accomplished January 1, 1897, at which time the management of the college farm will be turned over to the director of the Experiment Station. This transfer is made with such financial support from the College that the Hatch fund will not be encroached upon either temporarily or permanently. The capital necessary for carrying on the farm is furnished by the College. All expenses of management and instruction will be borne by the College. The station funds will be used as in the past, only to defray the cost of experiments.

The farm will be managed primarily as a dairy farm, although considerable attention will be given to swine, sheep and poultry husbandry. The crops grown will be largely hay, fodder, and silage crops. The management of the farm will be, as in the past, under the immediate charge of Professor Gowell.

REPORTS OF THE STATION STILL AVAILABLE FOR DISTRIBUTION.

The Station has a few hundred copies of the Reports for 1888, 1889, 1890, 1893, 1894 and 1895, which will be sent on application so long as the numbers on hand will allow. The Report of this Station is bound with that of the Secretary of Agriculture, so that anyone having the "Agriculture of Maine" has also the Report of this Station.

In order to guide one in asking for these publications the principal papers in each Report are named below.

Address all requests for publications to
Maine Agricultural Experiment Station,
Orono, Maine.

TABLE OF CONTENTS OF REPORTS OF THIS STATION FOR 1888, 1889, 1890, 1893, 1894, AND 1895.

REPORT FOR 1888.

Inspection of fertilizers. Digestion experiments with sheep. The compounding of rations for farm animals. The composition and digestibility of American feeding stuffs. Tests of varieties of potatoes, oats, barley, and peas. Germanation tests of seeds. Descriptions of the following injurious insects: Round-headed apple-tree borer; Flat-headed apple-tree borer; Oyster-shell bark louse; Apple-tree tent-caterpillar; Forest tent-caterpillar; Fall canker-worm; Eye-spotted bud-moth; Apple-tree aphis; Codling moth; Apple maggot; Ash-gray pinion; Pear-tree slug; Indian cetonia; Plum curculio; Cherry-tree plant-louse; Imported currant-worm; Ivy scale insect; Black swallow-tail butterfly; Eyed elater; Hawthorn tingis; Mourning cloak butterfly; Meal-worm beetle.

REPORT FOR 1889.

Inspection of fertilizers. Composition, digestibility and yield of hay from various grasses. Composition, digestibility and yield of corn-fodder. Composition and value of various commercial feeding stuffs. The comparative digestibility of wheat bran and wheat middlings. Composition and digestibility of pea meal. The value of the digestible matter of good hay as compared with the digestible matter of corn ensilage, for milk production. The value of the digestible matter of ensilage as compared with the digestible matter of hay, for growth. Feeding experiments with swine. Tests of several breeds of dairy cows. Field and pot experiments with fertilizers. Field tests with varieties of barley, oats and peas. Seed germination experiments. Experiments with forage plants. The potato rot. Apple scab. The apple maggot. Insecticides. Hog cholera. Parturient apoplexy, (milk fever). The coefficients of digestibility for protein. Loss of food and manurial value in selling sweet corn.

REPORT FOR 1890.

Inspection of fertilizers. Tests of dairy cows. Mechanical loss of butter fat. Effect of delay in setting milk. The mineral ingredients of milk. The fat globules of milk. Tuberculosis in the college herd. Feeding experiments with colts. Feeding experiments with steers. Feeding experiments with swine. Field experiments with fertilizers. Germination tests of seeds. Spraying experiments. Injurious insects. Meteorological operations.

REPORT FOR 1893.

Investigation of the foraging powers of some agricultural plants for phosphoric acid. The composition of fodders and silage from the corn plant. Digestion experiments with sheep. Corn as a silage crop. Feeding experiments. Feeding experiments with cows. Feeding experiments with swine. Waste of fat in the skimmed milk by the deep-setting process. Notes of cabbages, cauliflowers, tomatoes, egg plants and potatoes. Spraying experiments. Catalogue of Maine fruits. Bean and tomato anthracnose. Potato and beet scab. The Angoumois grain moth; the lime-tree winter-moth; the apple-leaf bucculatrix; the Disippus butterfly; the May beetle; the bean weevil; the pear-blight beetle or shot-borer; the carrot-fly.

REPORT FOR 1894.

Analyses of butter and imitation butter. Field experiments with fertilizers. The profitable amount of seed per acre for corn. Digestion experiments. Feeding experiments. Notes of potatoes and corn. Notes of small fruits and on plant breeding. The orange-colored roestelia or quince rust. Diseases of oats. Night-flowering catchfly. The dichotomous catchfly. Potato scab. The snow flea. The silver fish. The ring-banded soldier-bug. The elm tree bark louse. The gooseberry plant-louse. The oblique-banded carpet beetle. The oak-bark weevil. The fall canker worm. Tuberculin as a diagnostic agent. Bulletins issued in 1894—Fruit-culture. Spraying experiments. Tomatoes. Cauliflowers. Corn as a silage crop. Potatoes. Tuberculosis and glanders. A scheme for paying for cream, etc. Foraging powers of some agricultural plants.

REPORT FOR 1895.

Investigations on the foraging powers of some agricultural plants for phosphoric acid. The profitable amount of seed per acre for corn. Sunflower heads and blackeye peas as silage crops. Feeding experiments with milch cows. The relation of food to the growth and composition of the bodies of steers. Notes on potatoes, sweet corn, peas and cabbage. Notes on plants and insects. Second blooming of pear trees. Cattle lice. The yellow woolly bear. Tapestry moth. The strawberry leaf beetle. The cucumber flea beetle. The currant fly. Bulletins issued in 1895—Important facts about corn. Inspection of fertilizers. A Discussion of certain commercial fertilizers. A discussion of certain commercial foods. Notes on small fruits. Inspection of fertilizers.

ACKNOWLEDGMENTS.

Acknowledgment is hereby made for the following gifts to the Station during 1896:

One-half ton Thomas Phosphate Powder.—Thomas Phosphate Works, Philadelphia.

One Turbine Babcock Tester.—Vermont Farm Machine Company, Bellows Falls, Vermont.

One Peep O'Day Brooder.—E. F. Hudson, Dover, Mass.

One Improved Robbin Potato Planter.—Bateman Mfg. Co., Greenlock, New Jersey.

One Iron Age Sulky Cultivator.—Bateman Mfg. Co., Greenlock, New Jersey.

One New York Champion Horse Hay Rake.—Patten & Stafford, Canastata, New York.

One Bullard Two-Horse Hay Tedder.—Richardson Mfg. Co., Worcester, Mass.

One Deering Ideal, Ball and Roller Bearing Mower, six feet cut.—Deering Harvester Co., Albany, N. Y.

One Acme Pulverizing Harrow.—Duane H. Nash, Millington, N. J.

One Macomber Hand Corn Planter.—Duane H. Nash, Millington, N. J.

One Pound Protectio.—The Protectio Company, Collinsville, Conn.

One package Insecticide, Bug Death.—Danforth Chemical Co., Leominster, Mass.

One gallon prepared putty.—T. H. Nevins, Pittsburg, Pa.

One set Transplanting Implements.—F. Richards, Freeport, N. Y.

One package Cassa Banana Seeds.—J. L. Normand, Marchville, La.

One package Cions, eleven varieties.—C. Howard Shinn, Berkeley, Cal.

The following newspapers and other publications are kindly donated to the Station by the publishers:

Agricultural Epitomist, Indianapolis, Ind.; weekly. American Agriculturist, New York City; weekly. American Creamery, New York City; weekly. American Cultivator, Boston, Mass.; weekly. American Dairyman, New York City; weekly. American Fertilizer, Philadelphia, Pa.; monthly. American Grange Bulletin, Cincinnati, Ohio; weekly. Baltimore Weekly Sun, Baltimore, Md.; weekly. Cultivator & Country Gentleman, Albany, N. Y.; weekly. Dairy World, Chicago, Ill.; weekly. Detroit Free Press, Detroit, Mich.; bi-weekly. Elgin Dairy Report, Elgin, Ill.; weekly. Farming, Toronto, Ont.; monthly. Farmer's Advocate, Burlington, Vt.; weekly. Farmer's Advocate, London, Ont.; weekly. Farmer's Guide, Huntington, Ind.; weekly. Farmer's Home, Dayton, Ohio; weekly. Farmer's Journal, Philadelphia, Pa.; weekly. Farmer's Magazine, Springfield, Ill.; weekly. Farmer's Review, Chicago, Ill.; weekly. Farmer's Voice, Chicago, Ill.; weekly. The Florist's Exchange, New York City; weekly. The Forester, Princeton, N. J.; weekly. Fruit, Dunkirk, N. J.; weekly. Grange Visitor, Charlotte, Mich.; weekly. Green's Fruit Grower, Rochester, N. Y.; weekly. Hoard's Dairyman, Ft. Atkinson, Wis.; weekly. Holstein Fresian Register, Brattleboro, Vt.; monthly. The Homestead, Des Moines, Iowa; weekly. Horticulture, Cuyahoga Falls, Ohio; monthly. Horticultural Visitor, Kinmundy, Ill.; monthly. Industrial American, Lexington, Ky.; monthly. The Irrigation Age, Chicago, Ill.; monthly. The Jersey Bulletin, Indianapolis, Ind.; monthly. The Louisiana Planter, New Orleans, La.; monthly. Maine Farmer, Augusta, Me.; weekly. The Market Garden, Minneapolis, Minn.; weekly. Massachusetts Ploughman, Boston, Mass.; weekly. Mirror & Farmer, Manchester, N. H.; weekly. Montana Fruit Grower, Missoula, Mont. New England Farmer, Boston, Mass.; weekly. New England Florist, Boston, Mass.; weekly. New England Homestead, Springfield, Mass.; weekly. New York Farmer, Port Jervis, N. Y.; weekly. New York Produce Review, New York City; weekly. Northern Leader, Fort Fairfield, Me.; weekly. Ohio Farmer, Cleveland, Ohio; weekly. Ohio Valley Farmer, Cincinnati, Ohio; weekly. Orange County Farmer, Port Jervis, N. Y.; weekly. Oregon Agriculturist, Portland, Oregon; bi-weekly. Pacific Coast Dairyman, Tacoma, Wash.; weekly. Practical Farmer, Philadelphia, Pa.; weekly. Public Ledger, Philadelphia, Pa.; daily. Rural Californian, Los Angeles, Cal.; monthly. Rural Canadian, Toronto, Ont.; weekly. Rural New Yorker, New York City; weekly. Southern Cultivator, Atlanta, Ga.; weekly. Southern Farmer, New Orleans, La.; weekly. Southern Planter, Richmond, Va.; weekly. Southern States, Baltimore, Md.; monthly. Southwestern Farmer, Wicheta, Kans.; weekly. Success with the Garden, Rose Hill, N. Y.; monthly. Turf, Farm and Home, Waterville, Me.; weekly. Vick's Magazine, Rochester, N. Y.; monthly. Wallace's Farmer, Des Moines, Iowa; weekly. Weekly Call, San Francisco, Cal.; weekly. Western Agriculturist, Chicago, Ill.; weekly.

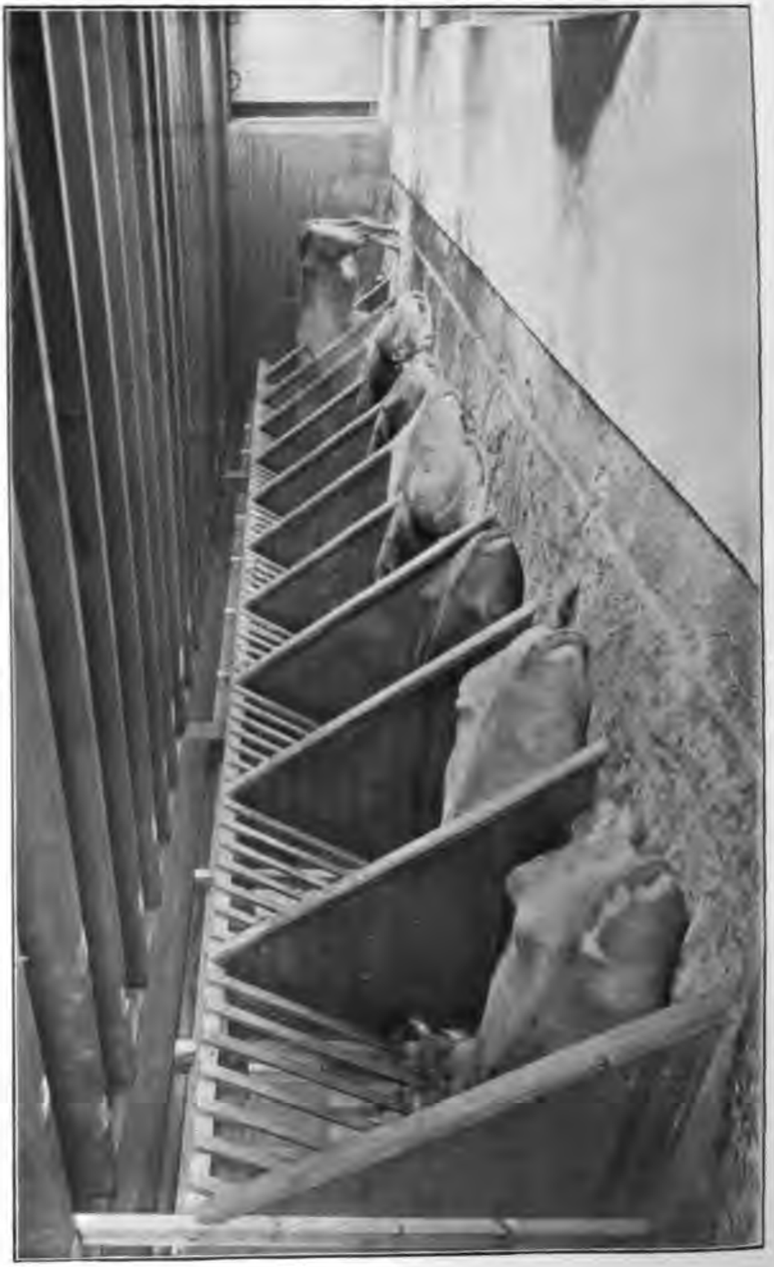
NEW FITTINGS OF THE COW STABLE.

G. M. GOWELL.

In the construction of the first cattle barn at the college, separate mangers were provided for each animal, but all stood upon one common platform which was raised four inches above the bottom of the manure trench. The cattle were fastened around the necks with common tie-chains. In fifty feet of the tie-up this platform was four feet and four inches wide, and in the other fifty feet, it was four feet and ten inches wide, the better to accommodate long and short cows.

The difficulty of keeping the animals clean caused us to raise the platform to ten inches above the trench. No other changes were made. With the low platform, one hour had been required for the man to card, brush and properly clean the twenty-nine cows. After the platform was raised it required sixteen minutes of the same man's time to keep them as clean as before. This record extended over several days, and represented fairly the time required with each floor. The advantage with the high platform was, that the cattle would not back down into the trench very frequently and track their voidings up on to the platform to soil themselves when they lay down, as they did when the low platform was used.

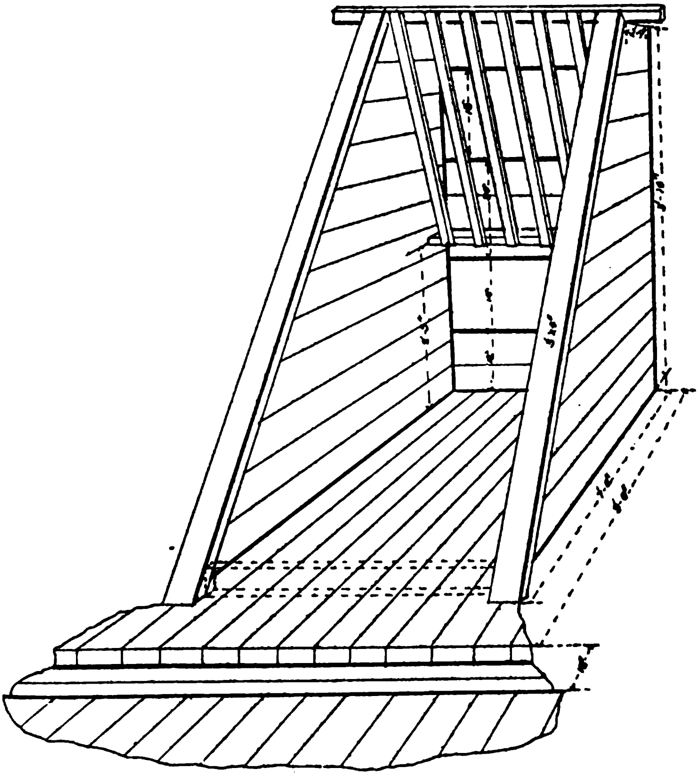
This high platform was not dangerous, causing animals to slip or fall, as is shown by our twelve years experience with it. We never had a case of lameness resulting from its use, and never a case of abortion in our herds, which, had it occurred, might perhaps have been ascribed to this as its cause. We encountered one difficulty in its use. When a cow lay down, the one standing next to her would sometimes step on her teats and bruise or cut them. This was not of frequent occurrence, but yet sufficiently so as to cause considerable trouble and anxiety. If we constructed partitions between the animals to prevent this difficulty they would be compelled to back out of their stalls down over the ten-inch drop into the trench, when we turned them out. This was not convenient for them to do. They had



TIE-UP IN LOWER BARN.

ordinarily turned on the high platform and walked off from it with ease; the partitions would prevent their doing so.

In reconstructing this barn last fall we attempted to secure some plan of stalls that would give the advantages of the one we already had and would at the same time be free from its objectionable features. It was decided to adopt the leading features of the "Hoard Stalls" and make such changes as seemed advisable to adapt it to our wants. The accompanying cut shows the plan and details of construction. The sleepers under the floor have no incline. The floor upon which the cows are placed is nine feet wide and has an incline of two inches in the nine feet. This incline is secured by laying pieces of tapering furring that are nine feet long, and are three inches thick at one end, and one inch thick at the other end, upon the sleepers, and laying the flooring upon them, using one thickness of plank or two thicknesses of boards.



At the side of the platform is the manure trench which is eighteen inches wide. The floor of this trench is made of one thickness of two inch plank laid directly on the floor sleepers. Narrow strips of one inch boards, for furring, are laid on the sleepers, from the manure trench to the outside sill of the barn, and are floored over with two inch plank, covered with one inch boards, breaking joints. When completed this leaves the trench two inches deep. Our stalls vary from three feet and four inches, to four feet in width; the wide ones being reserved for some of the larger animals. Three feet and six inches is about the right average width.

A convenient course to pursue in constructing the stalls is, first, to set the three by four inch studs at the corners of the stalls next to the feed floor of the barn, and then to put in place the eight inch plank which is the bottom of the feed rack and extends from post to post. The bottom of this plank should be twenty-nine inches from the floor, and its back edge should be beveled to take the narrow strips of the feed rack which are nailed to it. The top or head rail, which is two by four inches, is set at an angle, the upper corner being five feet and ten inches from the floor and twenty-eight inches from the front end of the stalls.

The partitions are a single thickness of one inch boards nailed to the three by four studs at the front end of the stalls, and extending back; the ends being cut on an angle to fit into the groove in the inclining three by four header which is nailed to the head rail at one end and the floor at the other end.

This header piece has its corners chamfered and the one inch deep groove is in the four inch side. The manger strips are one by two inches in size, and are placed four inches apart. The head rail is held in place by strips nailed to it and the front studs.

The top floor of the stalls is put down last and is of one inch boards running up and down the stalls. Pieces of three by four joist are placed on edge across the stalls near the ends of the partition and fastened to the floor by two large wire nails. The upper corners of these pieces are chamfered. They are to be put just in front of, and close to the hind feet of the animal when it stands up in the stall with its head close to the slats of the feed rack.

The lower door in front, through which grain and silage are fed is fourteen inches wide, and its lower edge is twelve inches from the floor. The upper door through which the hay is fed is eighteen inches wide and the space between it and the lower door is twenty inches. The doors are hinged at the upper edges and shut down, to avoid the crowding at the hinges, caused by chaff, etc., when hung to shut up. The animals are fastened by leather head halters, the ropes of which are two and one-half feet long, to the ring placed in the edge of the bottom of the feed rack.

The floor in the front part of the stall is swept clean before feeding the grain and silage, which are put directly on the floor. The animal steps forward putting its hind feet in front of the cross piece and eats the grain or silage and then, lifting its head is forced to step back over the cross piece in order to stand comfortably. The animal rarely voids while standing forward eating from the floor, but does so while standing back. When they are first put into the stalls they will sometimes lie down on the cross pieces but they get up very quickly and seek more comfortable positions by stepping in front of the bar and lying there, where there is plenty of room and comfort.

After the cows had been in their quarters about a month and had become accustomed to lying forward in the stalls, the cross pieces were removed. This was done several weeks ago, yet they have all continued to step forward when about to lie down, precisely as they did when the cross pieces were in place. How long they will continue to do so without the cross pieces to prompt them remains to be seen. The only objection to the cross pieces is that they are somewhat in the way of the milkers until they become accustomed to them. When leaving their stalls animals back out into or across the two inch deep manure trench without hesitation.

Our experience, thus far, with these stalls is very satisfactory. The animals have much freedom, as they step back and forth the length of their halters, and are able to reach back and lap themselves much to their satisfaction. They require but little carding and brushing to keep them clean, and while lying down they are safe from the injuries liable to be inflicted by their over-crowding mates.

The material used in the construction of these stalls was native spruce, planed on all sides. The cost of furnishing a barn with these stalls is less than that of stancheons, or mangers and chains. They are so sensible, simple and cheap, that they commend themselves to every cattle owner, whether he has an old fashioned barn or is constructing a new one.

A generous supply of windows is provided for the admission of light and sunshine. Outside windows are used during the coldest weather and are essential to prevent freezing in the tie-up, as it is kept open in front into the drive or feed floor except in the severest weather. This part of the barn furnishes plenty of fresh air to the animals, as it opens directly into the large ventilators on the ridge of the barn which are never closed. When it becomes necessary for the comfort of the animals, to close the shutters in front of them, the tie-up in which they are confined is completely ventilated by the ventilating shutes that are twelve by twenty-four inches, inside measurement, and extend from the tie-up, up the walls and roof to the ventilators at the ridge. These shutes are as near air tight as they can be made with matched boards and building paper, and have an upright height of forty-five feet.

It is essential that the ventilators be tight, as every little crack acts as a damper and checks the draft. It is necessary that the shutes be of large size, and as high as possible so as to displace large quantities of foul air. One of these shutes to each fifty feet in length of the tie-up, ventilates so completely that the air seems fresh and dry in the morning, after the room has been closed during the night. The cellar is ventilated by four shutes of similar size, but greater length, arranged in the same way.

For watering, two troughs are placed, in the one hundred feet long tie-up, next the wall, behind the cattle. A rope about two feet long is fastened near the ends of each trough. These ropes, and the ones in the stalls, have snaps at their ends, and the cattle are quickly unfastened and led to the trough and secured. Four animals are in process of watering at the same time. They cannot wander about, and the ropes are so short that they cannot play with each other and waste the time of the herdsman. After using individual watering buckets or fountains, of a good pattern, for two years, we have discarded them for the reasons that they get foul quickly and require much cleaning. They have valuable features and we gave them up with reluctance. Our troughs are emptied and cleaned twice every day and filled with fresh water.

The bull pens are on the opposite side of the barn from the tie-up. They are nine by sixteen feet in size and have substantial walls. For fastening the animal a steel rod ten feet long and one and one-fourth inches in diameter, is placed horizontally along one of the long sides of the pen, thirty inches from the floor and two inches from the wall. It is held in position by a strong bolt at each end, and held away from the wall by thick washers. A strong sliding ring with swivel is placed on the rod, and the bull is fastened to it with chain or halter. He is at liberty to get considerable exercise by walking back and forth the length of the rod and yet he is securely fastened. This arrangement saves the time of the attendant required in exercising the mature animal that is unsafe if turned loose in the yards, and it gives the creature a chance for voluntary exercise at all times.

ANALYSES OF FODDERS AND FEEDING STUFFS.

In connection with the work of the Station, analyses of the following miscellaneous feeding stuffs have been made by the Station chemists. For the most part the analyses were made in connection with the feeding experiments or experiments upon the growth of plants. In no case were they undertaken merely to increase the amount of this class of data. The methods of analyses recommended by the Association of Official Agricultural Chemists were employed.

The results of the analyses are given in the tables which follow:

COMPOSITION OF FODDERS AND FEEDING STUFFS ANALYZED IN 1896, CALCULATED TO WATER CONTENT AT TIME OF TAKING SAMPLE.

	Laboratory number.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat
		%	%	%	%	%	%
Sunflower heads	4004	86.07	1.10	1.93	3.79	5.62	1.49
Sunflower, whole plant	4005	85.21	1.92	1.70	4.00	6.14	1.03
English horse beans	4006	82.65	2.09	3.88	3.71	7.18	0.49
Silage—mature corn, sunflower heads, horse beans	599	70.33	1.73	3.44	6.33	16.44	1.73
Silage—mature corn, sunflower heads, horse beans	600	69.61	1.74	3.80	6.43	16.25	2.17
Silage—mature corn, sunflower heads, horse beans	601	69.89	1.58	4.25	5.79	16.80	1.69
Silage—mature corn, sunflower heads, horse beans	602	68.95	1.48	4.38	5.96	17.34	1.94
Maine Field Corn, planted at 6 inches	4001	80.64	1.18	1.91	3.76	11.90	0.60
Maine Field Corn, planted at 9 inches	4002	80.66	1.14	1.85	4.21	11.62	0.50
Maine Field Corn, planted at 12 inches	4003	79.26	1.25	2.21	4.09	12.60	0.59
King Gluten Meal	613	8.80	1.54	33.13	1.35	39.40	15.78
Potato Pomace	614	10.96	2.71	6.56	10.26	68.98	0.53
Juncus Gerardi	594	7.99	5.50	7.56	26.37	48.46	4.12

COMPOSITION OF WATER FREE SUBSTANCE OF FODDERS AND FEEDING STUFFS ANALYZED IN 1897.

	Laboratory number.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%
Sunflower heads	4004	7.89	13.87	27.20	40.33	10.70
Sunflower, whole plant.	4005	13.04	11.55	27.04	41.60	6.78
English horse beans	4006	12.07	22.34	21.41	41.35	2.82
Silage—mature corn, sunflower heads, horse beans	599	5.83	11.60	21.35	55.38	5.84
Silage—mature corn, sunflower heads, horse beans	600	5.75	12.50	21.15	53.50	7.10
Silage—mature corn, sunflower heads, horse beans	601	5.22	14.10	19.25	55.82	5.61
Silage—mature corn, sunflower heads, horse beans	602	4.60	14.10	19.20	55.86	6.24
Maine Field Corn planted at 6 inches	4001	6.10	9.88	19.40	61.49	3.10
Maine Field Corn planted at 9 inches	4002	5.88	9.58	21.79	60.16	2.59
Maine Field Corn planted at 12 inches	4003	6.04	10.68	19.70	60.74	2.86
King Gluten Meal	613	1.69	36.35	1.48	43.18	17.30
Potato Pomace	614	3.02	7.36	11.52	77.58	0.52
Juncus Gerardi	594	5.98	8.22	28.70	52.62	4.48

PROFITABLE AMOUNT OF SEED PER ACRE FOR CORN.

J. M. Bartlett.

This experiment was planned by Prof. Jordan and is a repetition of those made for the same purpose in 1894 and 1895.* An acre of land was used this season as before, and for a dressing it received fifteen two horse loads of stable manure, 250 pounds acid South Carolina Rock, 100 pounds nitrate of soda and 75 pounds muriate of potash.

The acre was divided into twelve plots, or four sets of plots with three plots in a set. The corn was planted May 19. On one plot in each set the single kernels were planted six inches apart, on another nine inches, and on the third twelve inches. This gave four plots or one-third of an acre planted by each method.

Great pains were taken to insure a stand of stalks in accordance with the plan, and the experiment appeared to be a success so far as the field work was concerned. The growth of the corn was all that could be desired and the crop produced was greater than ever before secured here by this method of planting. September 8-10, it was harvested and put in the silo, the kernels being well glazed and in the best condition for silage.

Below is given the composition of the 1896 crop and the ratio of yield for all three years.

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* Reports of this Station for 1894 p. 33 and 1895 p. 19.

COMPOSITION OF WATER FREE SUBSTANCE OF CORN (WHOLE PLANT) FROM VARYING QUANTITIES OF SEED.

DISTANCE PLANTED.	Laboratory number.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%
Kernels 6 inches apart	4001	6.10	9 87	19.42	61.47	3.10
Kernels 9 inches apart...............	4002	5.90	9.57	21.79	60.15	2.59
Kernels 12 inches apart.......	4003	6.03	10.66	19.72	60.75	2.84

YIELD PER ACRE OF CORN (WHOLE PLANT) FROM VARYING QUANTITIES OF SEED.

DISTANCE PLANTED.	CROP OF 1894.			CROP OF 1895.			CROP OF 1896.		
	Total yield.	Dry matter.	Yield dry matter.	Total yield.	Dry matter.	Yield dry matter.	Total yield.	Dry matter.	Yield dry matter.
	Lbs.	%	Lbs.	Lbs.	%	Lbs.	Lbs.	%	Lbs.
6 inches apart........	21,815	21.1	4,497	16,020	37.42	5,995	34,110	19.36	6,604
9 inches apart.......	22,580	20.9	4,709	15,780	38.47	6,071	34,680	19.32	6,700
12 inches apart........	20,190	20.5	4,139	15,675	35.45	5,558	31,815	20.74	6,598

The results so far reached indicate that the amount of seed may vary greatly without materially affecting the yield of dry matter in the mature crop. The average yield per acre of dry matter for the three seasons with the several rates of seeding are as follows: Kernels six inches apart 5,699 pounds; at nine inches 5,827 pounds; at twelve inches 5,432 pounds.

There appears so far to be only a small difference between six inches and nine inches seeding, whereas the yield from the twelve is considerably less.

SUNFLOWERS AND ENGLISH HORSE BEANS AS SILAGE CROPS.

J. M. BARTLETT.

For three seasons sunflowers have been grown on a small scale for a silage crop. In 1894 and 1895 very fair yields were secured but the season of 1896 was very favorable and an exceedingly heavy crop was the result.

Horse beans have been grown for two seasons, but owing to late planting and drought the crop of 1895 was not up to the average yield. In 1896 the seed was planted early for this climate, May 18th. The plants grew well, attaining a height of 3 to 4 feet, and contained many matured pods when harvested. A good yield was secured but it is possible that it could have been made somewhat larger, without impairing the quality, by planting somewhat closer. The plants stood about one foot apart in drills three to three and one-half feet apart.

Both crops were harvested September 8-10, run through the silage cutter and mixed with corn in the silo, in the following proportions: one-fourth acre of sunflowers, one-half acre of horse beans, and one acre of corn. The whole plant of one-half of the sunflowers was put in the silo mixed with corn and beans. Of the remaining half the heads only were used.

Both mixtures were found to be well preserved when the silo was opened in January, and were greedily eaten by the cows. The stalks of the sunflowers were so large and coarse that it seemed doubtful whether the cattle would eat them, but after being ensiled the mixture was as well relished as the pure corn. The cost of growing these crops can be estimated to be about the same as that of corn. The land should be put in about the same condition and the labor of caring for them is not materially different.

YIELD PER ACRE IN POUNDS.

NAMES OF PLANTS.	Weight as harvested.	Weight of dry matter.
Sunflower, heads	27,040	3,767
Sunflower, whole plant	48,800	7,219
English horse bean, whole plant	20,160	3,497

CHEMICAL COMPOSITION OF THE PLANTS.

	FRESH MATERIAL AS HARVESTED.						DRY MATERIAL (WATER FREE).				
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.
	%	%	%	%	%	%	%	%	%	%	%
Sunflower, heads	86.07	1.10	1.93	3.79	5.62	1.49	7.89	13.87	27.20	40.33	10.70
Sunflower (whole plant)	85.21	1.92	1.70	4.00	6.14	1.03	13.04	11.55	27.04	41.60	6.78
Horse bean (whole plant)	82.65	2.09	3.88	3.71	7.18	0.49	12.07	22.34	21.41	41.35	2.82

The very large yield of sunflowers (whole plant) per acre shown in the table above would apparently secure for them a favorable position among coarse fodder plants for silage material.

The yield of dry matter is slightly larger than has ever been obtained at the Station from corn, but notwithstanding that fact it cannot be considered as desirable a plant to raise for fodder where corn can be grown successfully. Its chemical composition is about the same as that of southern corn grown in this climate; the exceedingly coarse, rough stalks and leaves of the plant make it less palatable as a fodder and were it not ensiled would be largely rejected by stock.

The chief value, therefore, of the experiment with this plant consists in showing the utility of the silo in saving such materials and preventing waste. Sunflowers and other coarse plants are often grown for seed or other purposes when only a small portion of the plant is used. The coarse parts that were formerly thrown away can be now utilized and made into palatable and nutritious food for stock by ensiling.

Horse beans are rich in protein and promise to rank well with plants of that class as forage crops. They have the ability, like most legumes, to gather nitrogen from the air, and consequently do not exhaust the soil of that element. At the present time, however, when the price of nitrogenous feeds, like gluten meal and cotton seed meal, is so low, it is a question whether it is not more profitable for a farmer to give his attention largely to growing corn for coarse fodders and buy nitrogenous feeds to balance up the ration.

TESTS OF SEPARATORS.

J. M. Bartlett.

These tests were not undertaken with the idea of making an extensive investigation of separators, but to compare, principally for our own satisfaction, the three hand machines that are now in the dairy building; two of which, the Empire and United States, have been placed there free of cost for use in the dairy school. The DeLaval Company also supplied us with one of the Humming Bird machines for that purpose.

The machines used, sizes and capacities are shown in the table. The operator could detect no material difference in the ease of running of the United States No. 5 or Baby No. 2. The Empire being a larger machine of course ran harder. He, however, preferred the United States to the others on account of the simplicity of the bowl, it requiring less time to set it up, clean, etc.

If in handling the DeLaval discs they are arranged on a wire, the difference in time and work required to clean and set them up more than that required for one of the simpler bowls, is not so much as one would think.

In the first tests that were made the bowl washings were tested, to estimate losses in that direction, but as the amount of loss was about the same for each machine and the percentage was proportional to the amount of milk run through, this factor was disregarded in the experiment.

The determination of fat in the skimmed milk was made in most cases both by the gravimetric and the Babcock volumetric methods.

The Babcock method, the writer finds, is not reliable when the fat runs below .05 or .06 per cent, even when the B. & W. skimmed milk bottle is used. In several cases, not given in the table, where the Babcock method showed no fat or only a trace, the gravimetric showed .06 to .08 per cent. There are a great many chances for such small amounts of fat as are found in separator skimmed milk to become lost by sticking to the sides of the bottle when all conditions are not exactly right, and after it once adheres the centrifugal force used will not remove it. The results of the tests are here given in tabular form.

TESTS OF SEPARATORS.

KIND OF SEPARATOR.	Capacity of machine.	Time required for 100 pounds milk.	Revolutions of handle per minute.	Temperature of milk.	Fat in cream.	Fat in skimmed milk gravimetric method.	Fat in skimmed milk Babcock method.
U. S. Separator No. 5....	270 to 350	18 m.	45 to 48	85° F.	28.0	.04	.05
U. S. Separator No. 5 ...	270 to 350	19 m.	45 to 48	85° F.	29.0	.06	.04
U. S. Separator No. 5 ...	270 to 350	17 m.	45 to 48	85° F.	34.0	.12	.10
U. S. Separator No. 5....	270 to 350	17 m.	45 to 48	85° F.	35.0	.14	.13
De Laval Baby No. 2....	325 to 350	22 m.	40 to 42	85° F.	30.0	....	.06
De Laval Baby No. 2....	325 to 350	21 m.	40 to 42	85° F.	30.0	.06	.07
De Laval Baby No. 2....	325 to 350	20 m.	40 to 42	85° F.	33.0	.10	.09
De Laval Baby No. 2....	325 to 350	19 m.	40 to 42	85° F.	33.0	.09	.10
Empire No. 5	400	14 m.	45 to 48	85° F.	26.0	....	.05
Empire No. 5	400	13 m.	45 to 48	85° F.	28.4	....	.04
Empire No. 5	400	13 m.	45 to 48	85° F.	34.0	.11	.04

FEEDING EXPERIMENTS WITH MILCH COWS.

J. M. Bartlett.

(1) Gluten meal compared with cotton-seed meal for milch cows.

(2) Silage compared with grain as food for milch cows.

(3) Ground oats compared with wheat bran for milch cows.

(4) Nutriotone for the production of milk.

Feeding experiments with milch cows under ordinary conditions are somewhat unsatisfactory. There are many factors, beyond the experimenter's control, which come in to cause greater variations in milk yield than would be produced by any change in the ration one would care to make use of in rational feeding. Conclusive results are, therefore, not to be expected from single, brief feeding trials. It is only from the accumulated data of a large number of such trials that results of a reliable nature are obtained. Of course a very wide ration like that of timothy hay and corn meal will show its inferiority in a single feeding experiment, but the intelligent dairy farmer of today is already aware of that fact, and such irrational feeding experiments are no longer necessary. Considering the question as to whether a ration with a nutritive ratio of 1 to 4 or 1 to 6 is the more profitable, there are very little reliable data on which to base conclusions. Some of the most intelligent dairy farmers claim the best results from the very narrow ration of 1 to 4, while others are equally confident that the wider one of 1 to 6 is the better. It is in studying such problems as this in which results are not decisive that the single experiment is the most unsatisfactory, and it is only from the results of a large number of trials that definite information is obtained. The individuality of cows is a perplexing element in a feeding experiment. Cows are somewhat like people, and a ration that agrees best with one does not always agree with another.

Climatic conditions as heat and cold have a marked effect on some animals. A sudden drop in the temperature will sometimes cause a cow to shrink enough in milk flow to obliterate any difference in yield that might be produced by the food she is eating. Anything that causes nervous excitement may cause a temporary shrinkage in milk flow. A change of milkers, which one is sometimes obliged to make during an experiment, may cause difference enough in the milk yield to spoil the experiment. To eliminate some of these sources of error, the experimenter employs as many animals as practicable and takes careful note of all the conditions under which the experiment is made.

For the experiments which are given in the following pages, six registered Maine State Jerseys, known by the numbers 1, 2, 3, 4, 5 and 6, were used. Their ages ranged from 5 to 8 years, except Nos. 5 and 6, which were 3 and 4 years old respectively. All were fresh in milk and in good condition. Their milk flow was not quite up to their average for the reason that they were recently purchased, and transportation caused a shrinkage from which they did not recover.

In the experiments conducted with these animals they were divided into two groups or lots of three each, making it possible to feed the two rations to be compared through each period, thereby avoiding, to some extent, the errors caused by changes in temperature, advance in the period of lactation, etc.

In calculating the digestible nutrients in the foods used, the American coefficients were employed, except for corn meal, for which the German coefficients were used.

DIGESTION COEFFICENTS USED.

	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Hay	49	53	63	57
Silage	65	76	73	70
Corn meal	76	......	92	92
Gluten meal	87	......	91	88
Cotton-seed meal	88	......	64	97
Bran	78	25	68	72

GLUTEN MEAL COMPARED WITH COTTON-SEED MEAL AS FOOD FOR MILCH COWS.

The object of this experiment, the results of which are given in the following tables, was to compare the feeding value of gluten meal with cotton-seed meal, when fed in such proportions that the quantity of digestible nutrients of the one equalled those of the other.

Gluten meal, a material made from the residue left in the manufacture of starch and glucose from Indian corn or maize, is now offered quite extensively in our markets as a cattle food. There are also several other products made from this residue which are known by various names, such as gluten feed, corn bran, corn germ, etc. None of these, however, are so rich in protein as gluten meal, for the reason that in its manufacture the hull and germ of the kernel is removed, which is not the case in the manufacture of the other materials mentioned. The high grade meals do not differ greatly in composition from linseed meal and average about one-quarter less protein than cotton-seed meal. They also contain but little ash, and are less valuable than the oil meals as manure formers.

In this, as in all the other experiments, the animals were kept in as nearly uniform conditions as possible, and the grain ration fed was small so as to avoid an excess of nutrients in either ration. The cows were weighed at the beginning and close of each period, so that any gain or loss in flesh could be noted, and the milk was accurately weighed at each milking. Samples were taken the last five days of each period, and the average of the results obtained was taken as the average composition of the milk for that period. The butter made from the milk produced, while the cows were on each ration, was tested for quality and hardness.

WEIGHT OF COWS AT THE BEGINNING OF THE EXPERIMENT.

Cow's number	1	2	3	4	5	6
Weight in pounds	790	905	963	980	785	863

RATIONS FED DAILY.

Ration I.
Timothy hay, 15 lbs.; silage, 20 lbs.; mixed grain, 8 lbs. { Gluten meal, 3 lbs. Corn meal, 2 lbs. Bran, 3 lbs.

Ration II.
Timothy hay, 15 lbs.; silage, 20 lbs.; mixed grain, 8 lbs. { Cotton-seed meal, 2 lbs. Corn meal, 2¼ lbs. Bran, 3 lbs.

Cows Nos. 5 and 6 received but 6 and 7 pounds of grain respectively. The others received the full ration as given above.

COMPOSITION OF FOODS USED.

KINDS OF FOOD.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	%	%	%	%	%	%
Hay	13.2	4.4	5.9	29.0	45.0	2.5
Silage	69.9	1.6	4.0	6.0	16.6	1.9
Corn meal	14.4	1.4	9.3	1.9	69.2	3.8
Gluten meal	9.1	0.9	33.7	1.3	49.5	5.5
Cotton-seed meal	8.0	7.2	42.4	5.6	24.2	12.6
Bran	11.7	5.9	15.4	8.9	54.0	4.1

DIGESTIBLE NUTRIENTS CONSUMED BY EACH LOT OF COWS PER DAY.

KIND OF NUTRIENTS.	RATION I WITH GLUTEN MEAL.				RATION II WITH COTTON-SEED MEAL.			
	Period I. Lot I.	Period II. Lot II.	Period III. Lot I.	Average during tests.	Period I. Lot II.	Period II. Lot I.	Period III. Lot II.	Average during tests.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Protein	7.0	6.5	7.0	6.8	6.2	6.7	6.2	6.4
Carbohydrates	40.6	39.2	40.6	40.1	37.2	38.3	37.2	37.6
Fats	2.4	2.2	2.4	2.3	2.6	2.7	2.6	2.6

TEMPERATURE OF STABLE AND YIELD OF MILK FOR EACH COW PER WEEK.

PERIODS.*	Temperature of stable.	YIELD OF MILK PER COW.							
		Cow No. 1.	Cow No. 2.	Cow No. 3.	Total Cows 1—3.	Cow No. 4.	Cow No. 5.	Cow No. 6.	Total Cows 4—6.
	Deg.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
I. Dec. 3 to Dec. 21.									
First week	44	92.4	138.3	141.5	372.2	134.5	147.0	131.3	412.8
Second week.......	38	91.9	147.8	144.3	384.0	130.8	155.3	137.1	423.2
Third week	49	96.4	148.5	149.6	394.5	130.2	154.7	135.1	420.0
II. Dec. 22 to Jan. 11.									
First week	51	93.3	139.6	141.8	374.7	136.6	160.8	138.3	435.7
Second week..	49	93.4	136.6	140.9	370.9	130.0	162.5	135.6	428.1
Third week	35	92.0	132.4	133.9	358.3	127.6	158.6	134.6	420.8
III. Jan. 12 to Feb. 1.									
First week	43	99.1	143.3	137.5	379.9	129.0	155.5	136.7	421.2
Second week............. ...	42	92.4	135.6	131.9	359.9	125.9	150.6	128.0	404.5
Third week	41	91.0	130.8	125.0	346.8	121.1	150.0	123.6	394.7

* In periods I and III cows 1, 2 and 3 received the ration containing gluten meal, and cows 4, 5 and 6, that containing cotton-seed meal. In Period II the rations were reversed.

WEIGHT GAINED OR LOST, MILK, SOLIDS AND FAT PRODUCED BY EACH COW FOR EACH PERIOD.

	Period.	Cow's number.	Weight gained.	Weight lost.	Milk.	Solids.	Fat.
Ration I.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Gluten meal was fed.	I	1	....	25	280.6	40.3	14.1
	I	2	21	....	434.5	60.7	21.7
	I	3	....	8	435.4	63.3	22.5
	II	4	45	....	394.2	58.2	19.2
	II	5	....	10	481.9	68.7	22.1
	II	6	3	....	408.5	62.2	23.1
	III	1	5	....	282.5	40.2	14.0
	III	2	1	....	409.6	57.5	18.4
	III	3	2	....	394.4	56.5	20.2
Ration II.	I	4	35	....	395.5	58.9	20.1
	I	5	....	....	456.9	62.9	21.2
Cotton seed meal was fed.	I	6	9	....	403.5	60.8	22.6
	II	1	35	....	278.6	41.7	14.7
	II	2	16	....	408.6	57.1	20.9
	II	3	11	....	416.5	60.0	22.0
	III	4	....	8	376.0	55.6	18.5
	III	5	10	....	456.1	64.0	20.3
	III	6	15	......	388.4	59.7	22.5

TOTAL AND DAILY YIELD OF MILK, SOLIDS AND FAT FOR EACH LOT FOR EACH PERIOD.

Ration.	Period.	Weight gained.	Weight lost.	Milk.	Solids.	Fat.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
I. Gluten meal, Lot I..........................	I	......	12	1150.5	164.3	58.3
Average daily yield..........................	......	.....	....	18.3	2.6	0.92
I. Gluten meal, Lot II..........................	II	38	.. ..	1284.6	189.1	64.4
Average daily yield..........................	....	....	......	20.4	3.0	1.02
I. Gluten meal, Lot I..........................	III	8	.....	1086.5	154.2	52.6
Average daily yield..........................	......	......	.....	17.2	2.4	0.82
II. Cotton seed meal, Lot II..........................	I	44	......	1255.9	182.5	63.8
Average daily yield..........................	......	....	......	19.9	2.9	1.01
II. Cotton seed meal, Lot II..........................	II	62	.....	1103.7	158.7	57.5
Average daily yield..........................	......	.....	......	17.5	2.5	0.91
II. Cotton seed meal, Lot II..........................	III	17	......	1220.5	179.2	61.3
Average daily yield..........................	.....	......	......	19.4	2.8	0.97
I. Average daily yield gluten meal..........	. ..	......	......	18.6	.....	0.92
II. Average daily yield cotton seed meal.....	.....	......	......	18.9	....	0.96

DIGESTIBLE NUTRIENTS EATEN FOR EVERY POUND OF MILK, SOLIDS, AND FAT PRODUCED.

	RATION I WITH GLUTEN MEAL.								RATION II WITH COTTON-SEED MEAL.							
	Period I. Lot I.		Period II. Lot II.		Period III. Lot I.		Average during tests.		Period I. Lot II.		Period II. Lot I.		Period III. Lot II.		Average during tests.	
	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Milk....	.12	.83	.11	.72	.13	.89	.12	.81	.10	.71	.13	.84	.11	.74	.11	.76
Solids ..	.89	5.86	.72	4.91	.85	6.24	.85	5.67	.71	4.09	.89	5.88	.73	5.03	.78	5.00
Fat.....	2.53	16.53	2.12	14.44	2.79	18.24	2.48	16.40	2.05	14.17	2.45	16.21	2.13	14.71	2.21	15.03

SUMMARY.

The foregoing data indicate that gluten meal is fully equal to cotton-seed meal when fed in sufficient quantity to make the amount of digestible nutrients equal in each ration.

It is not equal to cotton-seed meal pound for pound as a source of protein, as it contains, on an average, about one quarter less of that nutrient.

It makes a very good quality of butter, but slightly softer than that made from cotton seed meal ration when fed in the quantity used in this experiment.

SILAGE COMPARED WITH GRAIN AS FOOD FOR MILCH COWS.

The object of this experiment was to again test the practicability of substituting silage, made according to Professor Robertson's formula, for a portion of the grain ration. The mixture was made as follows: One acre of matured field corn, one-half acre of horse beans, and one-quarter acre of sunflower heads, cut close, were run through the silage cutter and put in the silo. Owing to an unavoidable delay the corn was allowed to stand until too ripe and dry to make the best quality of silage.

The horse beans were rather immature, containing but few pods and were not at their best stage of growth for fodder. Owing to the dry condition of the corn, the silage did not keep well after the silo was opened and the time occupied by the experiment had to be cut down to two periods of two weeks each, which is shorter time than is desirable. With this exception the experiment may be considered a success. The silage was readily eaten and well relished by the cows. The gross amount of silage fed was not so large as in the experiment made in 1895 for the reason that the silage of 1896 contained considerable less water, but the total dry matter fed was about the same.

The ration fed for the first period was the same as fed in the third period of the experiment described above.

DAILY RATIONS FOR COWS.

Ration I. Timothy hay, 20 pounds; silage, 20 pounds; grain, 8 pounds.

Ration II. Timothy hay, 15 pounds; silage, 35 pounds; grain, 4 pounds.

Cows five and six received but six and seven pounds of grain respectively in the first period, and one-half that amount in the second period.

The results of the experiment are found in the following tables:

DIGESTIBLE NUTRIENTS CONSUMED BY EACH LOT OF COWS AND AVERAGE PER COW, PER DAY.

	Ration I.		Ration II.	
	Lot I.	Lot II.	Lot I.	Lot II.
	lbs.	lbs.	lbs.	lbs.
Protein	7.0	6.2	6.5	5.4
Carbohydrates	40.6	37.2	49.2	47.5
Fat	2.4	2.6	2.4	2.4
Total	50.0	46.0	57.4	55.3
Per cow	16.7	15.3	19.1	18.4

COMPOSITION OF MILK FOR LAST FIVE DAYS OF EACH PERIOD.

	Cow 1.		Cow 2.		Cow 3.		Cow 4.		Cow 5.		Cow 6.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%	%	%
January 28	14.41	4.80	13.93	4.80	14.24	4.95	14.75	4.80	14.47	4.55	15.28	5.80
January 29	13.62	4.90	13.87	5.20	14.17	5.30	14.64	5.10	13.35	4.50	14.97	5.55
January 30	13.94	4.80	14.56	4.95	14.46	5.20	14.88	4.80	13.74	4.20	15.7	6.00
January 31	14.64	5.30	14.14	4.80	14.45	5.05	14.81	4.85	14.20	4.50	15.62	6.00
February 1	14.52	5.05	13.77	5.00	14.30	5.10	14.86	5.00	14.21	4.55	15.31	5.65
Average	14.23	4.97	14.05	4.95	14.32	5.12	14.79	4.91	13.99	4.46	15.38	5.80
February 11	13.42	4.80	14.12	4.80	14.02	4.85	15.18	4.75	14.52	4.50	15.70	5.65
February 12	14.50	4.95	14.90	5.10	. ...	5.10	15.80	4.95	15.30	4.75	15.70	5.65
February 13	15.81	4.60	14.38	5.15	44.98	5.40	15.52	4.80	14.76	4.60	15.74	5.75
February 14	14.73	5.10	14.14	5.15	14.61	5.00	15.08	4.95	14.65	4.80	15.97	5.95
February 15	14.48	4.85	14.06	5.10	14.27	5.10	14.60	4.65	14.44	4.50	15.04	5.30
Average	14.59	4.86	14.32	5.06	14.47	5.09	15.23	4.82	14.73	4.63	15.63	5.66

TEMPERATURE OF STABLE AND YIELD OF MILK OF EACH COW PER WEEK.

	Temperature of stable.	1.	2.	3.	4.	5.	6.	Total.
Period I (Ration I).		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
January 19 to January 26	42	92.4	135.6	131.9	125.9	150.6	128.0	764.4
January 26 to February 1	41	91.0	130.8	125.0	121.1	151.0	123.6	741.5
Period II (Ration II).								
February 2—9	44	93.4	125.8	116.3	122.1	148.8	122.9	729.3
February 9—16	41	102.3	125.5	124.5	125.3	147.8	125.0	750.4

TOTAL YIELD OF MILK, SOLIDS AND FAT FOR EACH LOT OF COWS FOR EACH PERIOD.

	Period.	Weight gained.	Milk.	Solids.	Fat.
Ration I—full grain.	I.	lbs.	lbs.	lbs.	lbs.
Lot I		8			
Total yield			706.6	100.3	35.5
Daily yield per cow			16.8	2.4	.8
Lot II		17			
Total yield			800.3	117.4	40.2
Daily yield per cow			19.1	2.8	1.0
Ration II—one-half grain.	II.				
Lot I		70			
Total yield			687.6	99.4	34.5
Daily yield per cow			16.4	2.4	.8
Lot II		60			
Total yield			791.8	120.1	39.7
Daily yield per cow			18.9	2.9	.9

CONCLUSIONS DRAWN FROM THE FOREGOING DATA.

This experiment, although too limited to be of much value in itself, confirms the results of Professor Robertson's investigations and those obtained from experiments made at this Station last year, showing that silage, of the quality used, can be substituted in part for the grain ration of milch cows without causing loss of flesh or lessening the production of milk.

In this case fifteen pounds of silage appeared to equal four pounds of the grain mixture.

GROUND OATS COMPARED WITH WHEAT BRAN FOR MILCH COWS.

In some sections of the State oats are a very important crop and are extensively grown for market or feeding to animals. When the price is so low that it hardly pays to take them to market in exchange for other grains, the station receives frequent inquiries as to their value as feed for milch cows.

The grain is subject to quite wide variations in composition, depending somewhat on the variety, nature of the soil where grown, climatic conditions, etc. As a rule oats grown in high latitudes are heavier, contain less crude fiber and more nutrients than those grown farther south.

Good, heavy, northern grown oats do not vary greatly in composition from wheat bran, the principal difference being that they contain a little less protein, and ash materials. Their feeding value as far as has been determined is not materially different.

The average composition of northern grown oats and wheat bran is shown in the following table:

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	%	%	%	%	%	%
Oats	10.00	3.0	12.50	9.00	60.50	5.00
Bran	12.00	6.0	15.50	9.00	53.50	4.00

The chemical composition, the digestibility of the two being about the same, would indicate that bran is worth slightly more pound for pound than oats, but so far as they have been tested practically, there does not seem to be any material difference. In the test made at this station, the results of which are given in the following tables, the six cows previously described were used. They were divided into two lots of three each. Lot I received ration I and lot II, ration II, for the first period. The order was reversed in the second period, lot I receiving ration II; lot II, ration I. In the third period both lots were fed as in the first period.

RATIONS FED DAILY.

Ration I—Hay, 20 pounds, mixed grain, 8 pounds.	**Bran, 4 pounds.** **Corn meal, 2 pounds.** **Cotton seed meal, 2 pounds.**
Ration II—Hay, 20 pounds, mixed grain, 8 pounds,	**Ground oats, 4 pounds.** **Corn meal, 2 pounds.** **Cotton seed meal, 2 pounds.**

Cows No. 2, 3 and 4 received the full rations as given above, but Nos. 1 and 6 received but seven pounds of grain mixture, and No. 5 but six pounds.

CHEMICAL COMPOSITION OF FOODS USED.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	%	%	%	%	%	%
Hay	13.2	4.4	5.9	29.0	45.1	2.5
Mixed grain (Ration I)	10.7	5.0	21.1	6.9	49.9	6.5
Mixed grain (Ration II)	10.8	3.8	19.0	8.1	51.8	6.5

TOTAL NUTRIENTS CONSUMED BY EACH LOT FOR EACH PERIOD.

KINDS OF NUTRIENTS.	RATION I WITH BRAN.				RATION II WITH OATS.			
	Period I. Lot I.	Period II. Lot II.	Period III. Lot I.	Average during tests.	Period I. Lot II.	Period II. Lot I.	Period III. Lot II.	Average during tests.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs,	lbs.
Protein	175.6	166.8	175.6	172.7	157.7	165.7	157.7	160.4
Carbohydrates	1208.3	1184.5	1208.3	1200.4	1198.3	1218.4	1198.3	1205.0
Fats	62.3	59.6	62.3	61.4	59.8	62.5	59.8	60.7
Total	1446.2	1410.9	1446.2	1434.5	1415.8	1446.6	1415.8	1426.1
Total per cow per day	23.0	22.4	23.0	22.8	22.5	23.0	22.5	22.6

TEMPERATURE OF STABLE AND YIELD OF MILK FOR EACH COW PER WEEK.

Periods.	Temperature of stable.	Yield of Milk per Cow.							
		Cow No. 1.	Cow No. 2.	Cow No. 3.	Total Cows 1–3.	Cow No. 4.	Cow No. 5.	Cow No. 6.	Total Cows 4–6.
	Deg.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I—February 23—March 14.									
First week	41	87.1	112.0	113.1	312.2	119.1	124.4	108.4	351.9
Second week	45	83.5	107.8	112.4	303.7	121.4	131.1	109.0	361.5
Third week	41	81.9	106.0	111.4	299.3	122.0	128.4	112.6	363.0
Total		252.5	325.8	336.9	915.2	362.5	383.9	330.0	1076.4
II—March 15—April 4.									
First week	44	87.1	107.9	115.5	310.5	121.0	120.9	108.5	345.4
Second week	44	92.0	108.5	118.5	319.0	121.5	112.8	104.1	338.4
Third week	49	88 9	108.1	120.9	317.9	121.4	114.4	105.3	341.1
Total		268.0	324.5	354.9	947.4	363.9	348.1	312.9	1024.9
III—April 5—April 25.									
First week	50	90.1	101.5	118.5	310.1	125.8	104.8	102.6	333.2
Second week	56	88.5	100.4	119.1	308.0	130.6	102.0	100.5	333.1
Third week	55	86.0	98.3	120.3	304.6	128.9	99.1	107.6	335.6
Total		264.6	300.2	357.9	922.7	385.3	305.9	310.7	1001.9

AVERAGE COMPOSITION OF MILK FOR LAST FIVE DAYS OF EACH PERIOD.

	Cow 1.		Cow 2.		Cow 3.		Cow 4.		Cow 5.		Cow 6.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%	%	%
Period I	14.79	5.14	14.13	5.09	14.48	5.08	14.68	5.07	14.34	4.69	15.04	5.35
Period II	14.49	5.08	13.56	4.90	14.15	5.14	14.55	4.96	15.14	5.09	15.46	5.75
Period III	14.79	5.16	14.03	5.22	14.49	5.28	14.25	4.71	15.62	5.07	15.54	5.88

TOTAL YIELD OF MILK, SOLIDS AND FAT FOR EACH COW FOR EACH PERIOD.

	Period.	Cow.	Weight gained.	Weight lost.	Milk.	Solids.	Fat.
			lbs.	lbs.	lbs.	lbs.	lbs.
Ration I—Bran	I	1	...	4	252.5	37.4	13.0
		2	......	18	325.8	46.0	16.6
		3	.....	4	336.9	48.8	17.1
	II	4	20	......	363.9	53.0	18.1
		5	31	......	348.0	52.7	17.7
		6	55	......	312.9	46.4	18.0
	III	1	.....	18	264.6	39.1	13.7
		2	14	.....	300.1	42.1	15.7
		3	12	.....	357.9	51.9	18.9
Ration II—Oats	I	4	......	27	362.5	53.2	18.4
		5	12	......	383.9	55.0	18.0
		6	......	23	330.0	49.6	17.7
	II	1	29	.....	268.0	38.8	13.6
		2	35	......	324.5	44.0	15.9
		3	25	......	354.9	50.2	18.2
	III	4	3	......	385.3	54.9	18.1
		5	......	11	305.9	47.8	15.5
		6	......	25	310.8	48.3	18.3

TOTAL YIELD OF EACH LOT OF COWS FOR EACH PERIOD, AND AVERAGE DAILY YIELD FOR EACH COW.

RATION.	Period.	Weight gained.	Weight lost.	Milk.	Total solids.	Butter fat.
		lbs.	lbs.	lbs.	lbs.	lbs.
Bran—Lot I	I	....	26	915.2	132.2	46.7
Average daily yield	......	....	....	14.5	2.1	0.7
Bran—Lot II	II	106	....	1024.83	154.02	53.6
Average daily yield	.....	....	......	16.3	2.4	0.9
Bran—Lot I	III	8	....	932.6	133.1	48.2
Average daily yield	.....	....	......	14.6	2.1	0.8
Oats—Lot II	I	....	38	1076.4	157.9	54.1
Average daily yield	......	....	....	17.1	2.5	0.9
Oats—Lot I	II	89	....	947.4	133.0	47.8
Average daily yield	.....	....	....	15.0	2.1	0.8
Oats—Lot II	III	....	21	1001.9	151.0	51.9
Average daily yield	......	....	....	15.9	2.4	0.8

TOTAL YIELD OF MILK, TOTAL SOLIDS AND FAT WITH EACH RATION

	Milk.	Total solids.	Butter fat.
	lbs.	lbs.	lbs.
When ground oats were fed	2026	442	154
When bran was fed	1863	419	149

These results show a slightly larger yield when oats were fed than when bran was fed, but the differences are not sufficiently large for one to say that oats have a greater feeding value than bran. Changes in temperature of the stable, and other things that affect the condition of cows may cause even greater differences in yield of milk and butter fat than those shown in this experiment.

We, however, would have a right to infer that ground oats practically have a feeding value equal to bran, and when selling at about the same price, can be profitably substituted for it.

Their mechanical condition is such that they are equally good to mix with heavier feeds like corn, cotton seed, and gluten meals.

NUTRIOTONE FOR THE PRODUCTION OF MILK.

A feeding trial was undertaken with the above mentioned condiment, not with the expectation of obtaining any marked results, one way or the other, but as an object lesson to farmers who are spending their money for articles of that nature.

Nutriotone was taken in preference to any other compounds, not because it is believed to be any worse or better than any other of a like nature, but for the reason that it is being very extensively advertised and persistently sold by the company's agents, at the present time, not only as a curative agent, but as a stimulant to the production of flesh and milk. This impression seems to be substantiated by many inquiries, which have been made either verbally or by letter, to the station office during the past year. The company's agent in conversation with the writer denied that it was now being sold for any thing more than a tonic to be fed animals out of condition, but an inspection of the advertising matter, particularly the testimonials, would seem to indicate that a different argument is used to the consumer. We have here at the Station a two pound package which was recently sent in for examination. Upon this package are printed the following directions: "For Horses,—If your horse is in good condition, one large tablespoonful added to the food, twice daily, will keep him so with less grain. If in poor condition, blood out of order, hidebound, off his feed, has heaves, worms, etc., two tablespoonfulls mixed with each feed will soon put the horse in a thriving condition. Cows—Give two large tablespoonfuls with each feed. This will produce a great increase of much richer milk. Bullocks—Use two large tablespoonfuls for each feed and they will fatten in less time, with less expense and produce beef much superior in quality. They will have good appetites and not cloy."

From the foregoing directions it would certainly be impossible for one to get any other impression than that the Thorley Food Company, in its desire to increase the sale of its goods, is recommending them for use at all times whether the animals are in good or poor condition.

This experiment furnishes no evidence as to the value of nutriotone as a medicine. In fact, if the Station had been convinced that it was only being sold as such, the investigation would never have been undertaken. We do not, however, believe in purchasing these compounds as tonics or medicines for two reasons. One can tell nothing as to the quality, quantity, or effect of the ingredients they contain. The cost is, as a rule, about double what the drugs would cost bought alone without the filler.

If an animal is out of condition and really needs a tonic, the following could be given with safety and would probably be more effective than nutriotone. Pulverized gentian, 1 lb.; pulverized ginger, 1-4 lb.; pulverized saltpeter, 1-4 lb.; pulverized iron sulphate, 1-2 lb. Mix, and give one tablespoonful in the feed once a day for ten days. Omit for three days, then give ten days more. This mixture can be obtained for twenty cents a pound and has probably more than four times the value of most condimental foods in our markets, as a tonic for the reason it contains no filler like linseed meal or bran.

Other investigators have given this subject of condimental foods some attention.

Sir John B. Laws at Rothamstead, England, more than 50 years ago made thorough investigations in feeding trials and decided that there was no profit in feeding them. An experiment with nutriotone was reported by the Vermont Station Annual Report, 1894, page 150, in which seven Jersey cows were fed five periods of two weeks each. The hay and grain ration were the same throughout the trials. The prescribed amount of nutriotone was fed in the first, third and fifth periods. In the second period no nutriotone was fed and in the fourth two spoonfuls of linseed meal to each feed were substituted for it. The following table shows the total yield of milk and fat and the average per cent of fat for each period:

		Pounds of milk.	Per cent of fat.	Pounds of fat.
January 24—February 6.	Nutriotone fed	1554	5.47	84.78
February 7—20	No nutriotone fed	1566	5.55	86.83
February 21—March 6	Nutriotone fed	1514	5.42	82.02
March 7—20	Linseed meal fed	1531	5.37	82.22
March 21—April 3	Nutriotone fed	1449	5.45	78.96

For experiments, the results of which are given in the following tables, five good Jersey cows fresh in milk were used. They were known by the numbers 1, 2, 3, 4, 5. They were feed liberal rations of hay and grain in proportion to their size. Cows 1, 4 and 5 received a daily ration of 18 ℔s. of timothy hay and 8 1-2 ℔s. mixed grain per animal. Cows 2 and 3 received 20 ℔s. timothy hay and 10 ℔s. of mixed grain per day, for a ration. The grain mixture consisted of: Linseed meal (new process), 5 lbs.; corn meal, 2 lbs.; wheat bran, 3 lbs. The same care was used in making these experiments as in all others. The daily rations and milk produced were carefully weighed. Samples of the milk were taken the last five days of each period and analyzed, the averages of these results were taken as the average for the period in which they were obtained.

MILK YIELD PER WEEK FOR EACH COW FOR EACH PERIOD AND AVERAGE TEMPERATURE OF STABLE.

	Temperature of stable.	Milk Produced by Cows.					
		1.	2.	3.	4.	5.	Total.
October 24—November 14.		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First week	54°	141.2	200.3	188.8	162.4	142.7	835.4
Second week	53°	131.9	208.8	188.3	158.6	142.3	829.9
Third week	52°	125.7	190.0	177.0	150.2	134.1	777.0
November 15 to December 5.							
First week	46°	130.1	179.6	167.4	151.0	127.7	755.8
Second week	46°	128.6	185.0	166.6	151.5	129.7	761.4
Third week	44°	124.8	179.8	161.6	155.1	125.0	746.3
December 6 to 26.							
First week	48°	124.9	168.5	157.3	150.0	122.5	723.2
Second week	43°	120.9	170.0	151.8	146.2	118.3	707.2
Third week	37°	115.0	164.6	148.1	142.9	119.4	690.0

AVERAGE COMPOSITION OF MILK OF EACH COW WHEN NUTRIOTONE WAS FED AND WHEN IT WAS NOT FED.

Cows.	1.		2.		3.		4.		5.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%
No nutriotone	13.60	4.58	13.76	4.25	13.70	4.32	13.81	4.00	14.57	5.03
Nutriotone	13.75	4.52	13.77	4.35	13.77	4.39	13.83	4.11	14.62	5.02

YIELD OF MILK AND BUTTER-FAT FOR EACH COW FOR EACH PERIOD.

		Cows.					
		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	Total
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Period I—21 days—without nutriotone.	Milk	396.8	599.1	554.1	471.2	419.1	2442.3
	Fat	18.7	26.6	23.8	20.1	21.3	111.6
Period II—21 days—with nutriotone.	Milk	383.5	544.4	495.6	457.6	382.4	2263.5
	Fat	17.3	23.7	22.2	18.8	19.2	101.3
Period III—21 days—without nutriotone.	Milk	360.8	503.1	457.2	439.1	360.2	2120.4
	Fat	16.2	20.4	19.8	16.4	17.9	90.7

SUMMARY OF RESULTS WITH AND WITHOUT NUTRIOTONE.

	Milk.	Butter fat.
	Lbs.	Lbs.
Average for twenty-one days without nutriotone	2,281	101
Average for twenty-one days with nutriotone	2,264	101

The gradual shrinkage in these experiments is due to advance in period of lactation. In neither of these cases did nutriotone seem to have any effect, favorable or unfavorable. The slightly smaller milk flow with nutriotone does not mean anything in particular except to add increased emphasis to the falseness of the claim that two large tablespoonfuls fed with each feed "will produce a great increase of much richer milk." Of course the money spent for nutriotone in other cases was a dead loss. While there may be instances in which the purchase of a condimental food is financially profitable, it is significant that no exact experiments, conducted by disinterested parties, have shown a return equal to the cost.

EFFECTS OF TUBERCULIN ON TUBERCULOUS COWS.

F. L. Russell.

Since June 10, 1892, we have been testing cows with tuberculin, and during nearly all this time have had some tuberculous animals under observation. The tests, together with the autopsies held, have impressed upon us the fact that tuberculin is a very delicate agent for determining the presence of tuberculosis. It is very doubtful if cows ever react under a properly made tuberculin test unless they have tuberculosis. On the other hand, however, it is very evident that cows sometimes have tuberculosis or at least tuberculous growths in their bodies, and yet fail to react under the tuberculin test.

Others have observed that animals in an advanced stage of the disease sometimes fail to react, but we have had no experience of this sort. Unfortunately or otherwise, according to the standpoint from which we view the matter we have not treated many animals that were in a really bad physical condition. But during all our experience with tuberculin in testing cows we have been struck with the frequency of the failure of tuberculin to cause reaction in cows that were but slightly diseased. They will react at one time and not at another so that it is impossible to predict with any degree of certainty what the result of injecting tuberculin into a slightly diseased cow will be.

The results of the tests of animals with tuberculin extending over considerable periods of time are summed up as concisely as practicable, in a table at the end of this paper. A few of the most interesting and striking cases are discussed in the text immediately following.

One cow, Agnes, injected in June, 1892, underwent a plain reaction, and in the light of subsequent experience, we are bound to believe she was diseased at that time. The next time she was tested was a year and two days later when she failed to react.

During the next three years she was tested six times at intervals varying from twelve days to seven months and nineteen days, and she did not react until the last time she was tested, April 2, 1895, when she underwent what might be called a typical reaction with a maximum temperature of 106.3.

This case compels us to one of four conclusions: Either the test made in June, 1892, was misleading and the cow was not tuberculous at that time, or she recovered and later, in 1895, contracted the disease again; or she was diseased from June, 1892, to May, 1895, and repeated tests with tuberculin failed to reveal the fact; or the tuberculin injected in June, 1892, rendered her so tolerant of the drug that the tuberculin injected a little more than a year later had no effect. A few days before this cow was tested the last time, her udder was badly bruised—probably by the cow next to her stepping on it. For a time under the usual treatment she seemed to be making a good recovery from the injury and then steadily and rapidly grew worse. The swelling extended to the other quarter of the uddder on the same side, she developed a cough and was rapidly losing strength and flesh when she was killed, May 7, 1896. The autopsy revealed tuberculosis involving nearly all of one side of the udder, quite an area of one lung, the inguinal and mediastinal and many of the mesenteric lymphatic glands. There was.no doubt but the disease was making rapid progress.

Another case of some interest is a nineteen months old steer (No. 4) that had been tested three times with intervals of seven and one-half and four and one-half months. The last test was made twenty-six days before the autopsy and although the highest temperature observed at any test was 103, the autopsy revealed tuberculosis involving one mediastinal gland and a small area in the right lung. In both localities the tubercular tissue had undergone cheesy degeneration to such an extent as to leave no room for the idea that the disease was contracted after the last test was made only twenty-six days before.

Cows Nos. 5 and 6, were small, grade cows, related to each other and almost identical in appearance. They were always tested the same day and the results were similar to a remarkable degree. When first tested, August 17, 1894, neither reacted. Tested again January 8, 1895, both reacted, and both reacted again January 25, 1895. They were tested February 6, February 22, March 11, April 20, June 8 and August 1, and did not react at any of these times. They were killed August 22, 1895. The lungs of No. 5 and the lungs and a mediastinal gland of No. 6 contained small cheesy abscesses.

Dunkard Girl was tested first November 21, 1893, before she was a year old. Up to August, 1895, she had been tested six times without reacting. August 13, 1895, she reacted with a temperature of 107.4. August 29, 1895, she was tested again and reacted with exactly the same maximum temperature, 107.4. During September, 1895, she was tested twice and did not react. October 8, 14 days after the last test in September, she reacted with a maximum temperature of 105. She was tested October 19 and October 31, and failed to react. Tested November 20, she reacted with a temperature of 104.8. December 7 she did not react. January 3, 1896, she reacted with a temperature of 106.2. From January 3, 1896, to January 13, 1897, when she was tested the last time, she was given eight tests. The longest intervals being one and one-half month, and four and one-half months, but she failed to react after January 3, 1896. January 15, 1897, she was killed and tubercular lesions of the right lung and of two mediastinal glands were found.

August 13, 1895, a two-months-old heifer Kate, was tested and failed to react. February 14, 1896, she was tested again and did react. From that time to November 3, 1896, she was tested eight times at various intervals, and at each time failed to react, and she has not been tested since.

In considering these cases and others, the records of which are given in the accompanying tables, we notice that, although the animals were all undobtedly tuberculous, out of the 116 tests made, there were 33 reactions and 83 failures. Steer No. 4 did not react at all, but we count the last time he was tested among the failures to react, as the autopsy held twenty-six days later proved that he must have been diseased at the time that test was made.

Why is it that these animals were sometimes affected by tuberculin and at other times not affected?

The amount of tuberculin used in making the injections has been uniform for the same stage of maturity, yet the results have differed widely. In these cases, where the animals were so slightly diseased that their condition could not be detected by a physical examination, the results have differed so widely that we are forced to the conclusion that we can never tell whether a slightly diseased animal will react to the tuberculin test or not. A reaction may be obtained to-day and again next month, or as in the case of the cow Agnes, reaction may fail for nearly three years and then there be a very decided reaction.

We do not believe that tuberculin is poisonous for cows one day and not another, but our experience might lend some color to such a conclusion. That there is some law underlying the whole matter we believe must be true, but we have not yet seen any satisfactory statement of what the law is.

The theory has been quite generally advanced that aside from a possible curative action, one dose of tuberculin influences the action of the next dose even though it is injected after a considerable interval, the length of time being variously estimated. In view of the facts that animals do not usually acquire a tolerance, either temporary or permanent, for vegetable poisons as the result of one moderate dose; that some tuberculous animals react repeatedly to tuberculin and others do not; and that the intervals between reactions even in our limited experience varies from two days to more than a year, we see no grounds for supporting the theory that the failure of tuberculous animals to react to tuberculin is due to an acquired tolerance of tuberculin.

It is not a wild assumption that the growth of tubercle bacilli in diseased cows keeps their systems charged with tuberculin nearly up to and sometimes a little beyond the point where it manifests its poisonous effects in elevation of temperature. Such animals, charged to the danger point with tuberculin, readily react to a slight addition. The cow that has been taken at a disadvantage and has contracted tuberculosis and then so far recovers as to hold the disease in check, may be compared to the well cow so far as the action of tuberculin is concerned, since her system is free, or comparatively free, from tuberculin and no reaction follows the giving of the usual test dose.

Our experience has suggested to us the possibility that the failure of tuberculin to cause reaction in tuberculous cows at times may be due to the fact that the disease is not making steady progress.

In the following table there are given the condensed results of the more important cases studied by the Station. As stated in another part of this report* the Station has a herd of ten cows, which have reacted at least once, under investigation. The results here presented are given as a contribution to knowledge upon this important question and are not presented to prove or disprove any particular theory.

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* See page 14 this Report.

TABLE GIVING THE RESULTS OF TESTS WITH TUBERCULIN MADE AT THE STATION DURING THE YEARS 1892 TO 1896.

DATE OF TEST.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
Topaz.					
February 14, 1896.....	First test..	102.1	**105.3**	**3.2**	**Reaction.**
March 8, 1896	23	101.8	102.2	.4	No reaction.
March 13, 1896	5	102.2	102.8	.6	No reaction.
March 21, 1896	8	102.3	101.8	—.5	No reaction.
May 1, 1896	41	102.	101.9	—.1	No reaction.
July 2, 1896....	62	102.6	101.9	—.7	No reaction.
August 18, 1896	47	102.4	102.	—.4	No reaction.
September 15, 1896....	28	102.2	Temperature not taken.		
November 3, 1896.....	49	101.8	101.8	... .	No reaction.
December 9, 1896. ..	36	101.8	102.2	.4	No reaction.
January 13, 1897	35	102.	**105.2**	**3.2**	**Reaction.**
January 27, 1897	14	101.6	102.9	1.3	No reaction.
February 17, 1897	21	100.9	101.6	.7	No reaction.
Merrill.					
May 24, 1893...........	First test..	101.9	**105.5**	**3.6**	**Reaction.**
November 14, 1893...	175	99.4	102.2	2.8	No reaction.
December 1, 1893. ...	17	100.7	100.4	.3	No reaction.

RESULTS OF TESTS WITH TUBERCULIN—CONTINUED.

DATE OF TEST.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
Agnes.					
June 21, 1892	First test..	101.	**104.4**	**3.4**	**Reaction.**
June 23, 1893	367	101.4	102.2	.8	No reaction.
December 25, 1893 ...	188	101.	101.4	.4	No reaction.
August 16, 1894	231	101.8	102.	.2	No reaction.
January 8, 1895	145	100.9	102.	1.1	No reaction.
February 6, 1895	29	100.9	101.3	.4	No reaction.
April 20, 1895	73	101.3	**106.3**	**5.0**	**Reaction.**
Steer 4.					
December 27, 1893....	First test..	102.4	103.	.6	No reaction.
August 17, 1894	233	103.	102.1	—.9	No reaction.
January 8, 1885.......	144	101.4	102.8	1.4	No reaction.
Cow 5.					
August 17, 1894	First test..	100.9	102.	1.1	No reaction.
January 8, 1895	144	100.7	**105.2**	**4.5**	**Reaction.**
January 25, 1895	17	101.1	**105.4**	**4.3**	**Reaction.**
February 6, 1895......	12	100.6	101.8	1.2	No reaction.
February 22, 1895.....	16	101.8	102.	.2	No reaction.
March 12, 1895	18	100.6	102.	1.4	No reaction.
April 20, 1895	39	101.	102.4	1.4	No reaction.
June 8, 1895	49	101.4	101.	—.4	No reaction.
August 1, 1895	54	101.7	102.	.3	No reaction.
Cow 6.					
August 17, 1894	First test..	101.8	102.5	....	No reaction.
January 8, 1895	144	100.8	**104.4**	**3.6**	**Reaction.**
January 25, 1895	17	101.3	**104.**	**2.7**	**Reaction.**
February 6, 1895......	12	101.9	102.2	.3	No reaction.
February 22, 1895.....	16	101.6	101.6	.0	No reaction.
March 12, 1895	18	100.8	102.4	1.6	No reaction.
April 20, 1895	39	101.3	101.2	—.1	No reaction.
June 8, 1895	49	101.3	102.	.7	No reaction.
August 1, 1895	54	101.7	102.	.3	No reaction.
Dunkard Girl.					
August 13, 1895	116	101.	**107.4**	**6.4**	**Reaction.**
August 29, 1895	16	101.6	**107.4**	**5.8**	**Reaction.**
September 4, 1895	6	101.4	102.5	1.1	No reaction.
September 14, 1895 ...	10	102.6	101.4	—1.2	No reaction.
October 8, 1895........	424	102.7	**105.**	**2.3**	**Reaction.**
October 19, 1895.......	10	101.6	Temperature not taken.		
October 31, 1895.......	12	101.7	102.4	.7	No reaction.
November 20, 1895 ...	20	101.8	**104.8**	**3.**	**Reaction.**
December 7, 1895.....	17	101.	101.9	.9	No reaction.
January 3, 1896	27	102.	**106.2**	**4.2**	**Reaction.**
January 10, 1896	7	101.6	101.2	—.4	No reaction.
January 24, 1896	14	101.3	101.2	—.1	No reaction.
February 19, 1896....	26	101.5	100.9	—.6	No reaction.
July 2, 1896...... ...	134	102.	103.	1.	No reaction.
August 18, 1896	47	101.7	101.6	—.1	No reaction.
September 16, 1896 ...	29	101.7	Temperature not taken.		
November 3, 1896.....	49	103.	101.4	—1.6	No reaction.
January 13, 1897	72	101.5	102.4	.9	No reaction.

RESULTS OF TESTS WITH TUBERCULIN—CONTINUED.

DATE OF TEST.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
Kate.					
February 14, 1896....	185	100.3	**105.3**	**5.**	**Reaction.**
March 8, 1896	23	101.4	102.8	1.4	No reaction.
March 13, 1896	5	100.4	102.6	2.2	No reaction.
March 21, 1896	8	101.6	102.	.4	No reaction.
May 1, 1896...........	41	101.1	101.8	.7	No reaction.
July 2, 1896...	62	102.8	102.5	—.3	No reaction.
August 18, 1896	47	101.7	102.3	.6	No reaction.
September 15, 1896 ...	28	101.3	Temperature not taken.		
November 3, 1896.....	49	103.	103.	....	No reaction.
Mina D.					
April 30, 1896	72	101.2	**105.9**	**4.7**	**Reaction.**
July 2, 1896	63	101.7	**105.8**	**4.1**	**Reaction.**
July 7, 1896	5	101.3	102.7	1.4	No reaction.
August 18, 1896	42	101.8	**104.8**	**3.**	**Reaction.**
August 20, 1896	2	102.7	102.7	....	No reaction.
August 29, 1896	9	102.3	102.7	.4	No reaction.
September 15, 1896 ...	17	101.8	Temperature not taken.		
November 3, 1896.....	49	101.1	102.3	1.2	No reaction.
Ruth C.					
February 14, 1896.....	100	101.2	**106.**	**4.8**	**Reaction.**
March 8, 1896	23	100.8	**103.6**	**2.8**	**Reaction.**
March 13, 1896	5	101.7	100.8	—.9	No reaction.
March 21, 1896	8	101.6	101.7	.1	No reaction.
April 30, 1896	40	103.	101.6	—1.4	No reaction.
July 2, 1896...........	63	102.2	**105.2**	**2.9**	**Reaction.**
July 7, 1896......... ...	5	101.5	101.3	—.2	No reaction.
August 18, 1896	42	102.7	**104.3**	**1.6**	**Reaction.**
August 20, 1896	2	103.4	101.8	—1.6	No reaction.
August 29, 1896	9	103.	102.2	—.8	No reaction.
September 15, 1896 ...	17	102.	Temperature not taken.		
November 3, 1896.....	49	102.1	102.5	.4	No reaction.
December 9, 1896.....	36	101.3	101.2	—.1	No reaction.
January 13, 1897	35	101.6	102.	.4	No reaction.
January 27, 1897	14	100.6	103.	2.4	No reaction.
February 17, 1897.....	21	100.8	101.3	.5	No reaction.
Agnes 2.					
February 14, 1896.....	100	101.8	**106.**	**4.2**	**Reaction.**
March 8, 1896	23	102.6	**104.**	**1.4**	**Reaction.**
March 13, 1896	5	101.	**103.2**	**2.2**	**Doubtful.**
March 21, 1896	8	101.4	Temperature not taken.		
April 30, 1896	40	101.2	100.	—1.2	No reaction.
July 2, 1896......	63	102.7	**103.7**	**1.**	**Doubtful**
August 18, 1896........	46	102.1	102.3	.2	No reaction.
September 15, 1896 ...	28	101.8	Temperature not taken.		
November 3, 1896.....	49	102.2	102.2	....	No reaction.
Hallie.					
February 14, 1896.....	100	101.7	**106.6**	**4.9**	**Reaction.**
March 8, 1896..........	13	102.	**105.6**	**3.6**	**Reaction**
March 13, 1896	5	102.2	**103.5**	**1.3**	**Doubtful.**
March 21, 1896	8	100.2	102.2	2.	No reaction.
April 30, 1896	40	103.1	**104.3**	**1.2**	**Doubtful.**
July 2, 1896...........	63	101.8	**103.4**	**1.6**	**Doubtful**
July 7, 1896......... .	5	101.3	101.7	.4	No reaction.
August 18, 1896	42	102.	**105.2**	**3.2**	**Reaction.**
August 20, 1896	2	101.8	**105.1**	**3.3**	**Reaction.**

RESULTS OF TESTS WITH TUBERCULIN—CONCLUDED.

DATE OF TEST.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
August 29, 1896.... . .	9	101.2	102.	.8	No reaction.
September 15, 1896 ...	17	101.7	Temperature not taken.		
November 2, 1896.....	48	101.7	101.6	.1	No reaction.
February 17, 1897....	97	101.6	**105.3**	**3.7**	**Reaction**
Grace 2.					
February 14, 1896.....	100	99.6	**106.5**	**6.9**	**Reaction.**
March 8, 1896	23	102.	**105.5**	**3.5**	**Reaction.**
March 13, 1896	5	102.	102.8	.8	No reaction.
April 30, 1896..........	48	100.	100.2	.2	No reaction.
July 2, 1896	63	102.3	**104.7**	**2.4**	**Reaction.**
July 7, 1896......	5	101.7	101.8	.1	No reaction.
August 18, 1896	42	102.	102.	....	No reaction.
September 15, 1896 ...	28	101.4	Temperature not taken.		
November 3, 1896....	49	101.5	102.2	.7	No reaction.
December 9, 1896.....	37	101.4	102.5	1.1	No reaction.
January 13, 1897	35	102.1	102.	.1	No reaction.
January 27, 1897	14	100.8	102.4	1.6	No reaction.
February 17, 1897.....	21	101.5	**104.1**	**2.1**	**Reaction.**
Melinda 2.					
February 14, 1896	100	101.5	**106.**	**4.5**	**Reaction.**
March 8, 1896	23	101.2	**104.**	**2.8**	**Reaction.**
March 13, 1896	5	99.8	100.9	1.1	No reaction.
March 21, 1896	8	101.7	101.4	—.3	No reaction.
May 1, 1896............	41	100.3	101.4	1.4	No reaction.
July 2, 1896.....	62	102.	102.7	.7	No reaction.
August 18, 1896	47	101.9	102.	.1	No reaction.
September 15, 1896 ...	28	101.3	Temperature not taken.		
November 3, 1896...	49	102.	102.1	.1	No reaction.
December 9, 1896....	36	99.	101.4	2.4	No reaction.
January 13, 1897	35	102.	102.8	.8	No reaction.
January 27, 1897	14	100.5	102.5	2.	No reaction.
February 17, 1897.....	21	102.4	102.2	.2	No reaction.
Trilby.					
February 14, 1896.....	First test..	102.	**106.3**	**4.3**	**Reaction.**
March 8, 1896	23	101.	**105.3**	**4.3**	**Reaction.**
March 13, 1896	5	101.7	103.2	1.5	No reaction.
March 21, 1896	8	101.8	102.1	.3	No reaction.
May 1, 1896.....	41	102.1	101.6	—.5	No reaction.
July 2, 1896............	62	102.7	**105.5**	**2.8**	**Reaction.**
July 7, 1896............	5	102.	101.7	—.3	No reaction.
August 18, 1896........	42	102.5	103.2	.7	No reaction.
September 15, 1896 ...	28	101.9	Temperature not taken.		
November 3, 1896	49	102.	102.	....	No reaction.
December 9, 1896....	36	102.	102.2	.2	No reaction.
January 13, 1897	35	101.8	102.	.2	No reaction.
January 27, 1897	14	100.8	102.7	1.9	No reaction.
February 17, 1897	21	100.4	102.	1.6	No reaction.

ORCHARD NOTES.

W. M. MUNSON.

THE STATION ORCHARDS.

In reponse to oft repeated requests for information as to the exact condition of the orchard at the Experiment Station, a somewhat detailed statement is herewith given. In justice to ourselves, however, it should be said that we are not ready to draw conclusions, and this statement is but preparatory to a fuller discussion in a future report.

I. THE PLUM ORCHARD.

The nucleus of the plum orchard was started in the spring of 1889, when several varieties were procured and set in nursery rows. Several more were added in 1890. The effects of the severe winter of 1890 and 1891 were detailed in the annual report of the Experiment Station for 1891.

In 1892 the trees were removed from nursery rows to their present location and several others were added. Some of these have done well; others, as was expected, have failed.

The orchard is situated on heavy clay loam with stiff clay subsoil. The surface drainage is good, but as the land has not been tilled for some years, it was not in good condition for the orchard.

The following notes represent the condition of the orchard at the close of the season in 1896. The numbers refer to the Station records.

American Eagle, 56—Set in 1893. Moderately vigorous. Wood not matured. Kills back somewhat every year.

Arch Duke, 65—Young tree set in 1895. Failed to start. This place was originally occupied by Wild Goose.

Bunker Hill, 29 and 30—29, moderately vigorous, upright. A black knot found on the side of the tree. 30, vigorous, upright, healthy. A good tree.

Cheney, 79 and 80—79, young tree set in 1895. Vigorous. Wood not quite mature. 80, set in 1892. Very vigorous, upright. Wood not fully matured. Top broken off below the branches in the fall of 1893. Now making a good growth.

Coe's Golden, 8, 9 and 10—Moderately vigorous. Fruit spurs well developed. Small amount of fruit on No. 9 in 1893.

Czar, 50—Set in 1895. Has made very slow growth.

Damson, 20—Moderately vigorous, upright. Full crop of fruit in 1896.

DeCaraduc, 69—Set in 1892. The original tree was killed to the ground. Present top is a sprout from the base. The variety is not hardy.

Deep Creek, 45—Set in 1893. Small tree making a weak growth.

De Soto, 55—Set in 1893. Very vigorous, hardy. Wood well matured.

Duane Purple, 17 and 18—17, very vigorous, upright, strong, hardy, healthy. 18, same remarks apply as to 17. Centre of the tree was removed in 1895, but wound is healing well.

Early Red, 95 and 96—A Russian variety. Both are vigorous, upright, hardy. 96, bore a full crop of fruit in 1896. Growth checked.

Field, 35—Moderately vigorous. In good condition. Wood not quite matured. Blossomed, but bore no fruit, in 1896.

French Damson, 33—Set in 1893. Moderately vigorous. Young wood not fully matured.

Forest Garden, 41 and 42—41 set in 1895, replacing the original one of the same variety. Vigorous, hardy, healthy. 42, set in 1893. Very vigorous, hardy. Bore a few fruits in 1896.

German Prune, 2—Hardy, vigorous. In good condition.

Gueii, 23—Young tree set in 1894. Very vigorous. In good condition.

Hawkeye, 59—Set in 1893. Hardy, vigorous, strong. Wood well matured. Very few fruits in 1896.

Hudson River Purple Egg, 31—Very vigorous, upright, hardy. In good condition.

Hungarian Prune, 72—Set in 1892. Moderately vigorous, upright, hardy.

Imperial Gage, 22—Very vigorous, upright. In good condition.

Italian Prune, 3 and 13—Hardy, moderately vigorous. In good condition. Few fruit spurs.

Jefferson, 14—Injured and part of the tree removed in 1894. Tree now moderately vigorous and healthy. Fruit spurs well developed.

Lincoln, 38—Set in 1893. A small, misshapen tree, but now growing well.

Lombard, 1—Vigorous, healthy; one side broken by careless workmen.

Lone Star, 57—Set in 1893 and again in 1895. Killed both times.

Marianna, 51 and 52—Set in 1892. Very vigorous, hardy, spreading. Bore small amount of fruit in 1896.

McLaughlin, 15, 24, 25, and 26—15, badly checked in 1893. Now making a strong, vigorous growth. 24, small, weak tree. Will be replaced. 25, badly checked when removed from the nursery, but now making a vigorous growth. 26, moderately vigorous, spreading. In good condition. One black knot was found on this tree.

Newman, 65—Very vigorous, but tender. Kills back every winter. Worthless for this location.

No. 19 Orel, 81 and 82—A Russian variety of moderately vigorous, upright growth. Perfectly hardy. One black knot found. 82, injured in the trunk, and will probably not be long lived.

No. 20 Orel, 83 and 84—83, the original tree died. Sprouts from the roots of questionable value. 84, vigorous, upright, hardy. No fruit as yet, but promises well for 1897.

Osage, 48—Killed back every year. Died in July, 1896.

Peter's Yellow Gage, 21—Moderately vigorous, upright. In good condition. Tops of shoots not quite matured in the autumn.

Pond's Seedling, 27—Very vigorous, upright grower. In good condition.

Pottawatomie, 44—Set in 1893. Killed back first winter. New top formed from the side shoots. Making a vigorous growth, but wood fails to mature. Not hardy.

Prince Englebert, 28—Vigorous, upright. In good condition.

Prince of Wales, 34—Set in 1893. Vigorous, upright. Young wood immature. One black knot found.

Purple Yosemite, 49—Young tree set in 1895. Very vigorous. Wood well matured. The original tree set in 1893, never started.

Quackenbos, 6—Strong, vigorous grower. In good condition.

Reine Claude, 7—A fine tree. Moderately vigorous. In good condition.

Robinson, 54—Set in 1893. Killed back every year. Wood not matured.

Rockford, 43—Set in 1895. Small tree making a good growth, but wood not quite mature.

Rolling Stone, 75 and 76—75, moderately vigorous, spreading, hardy. 76, making a very vigorous growth. In fine condition.

Saratoga, 40—Set in 1895. Moderately vigorous, healthy. Wood well matured.

Smith's Orleans, 16—Strong, vigorous, hardy. A fine tree. No fruit as yet.

Spaulding, 39—Set in 1895. Healthy. Making a moderately vigorous growth.

Van Buren, 32 and 60—60, very vigorous. Wood well matured. Blossomed, but matured no fruit in 1896. 32, young tree set in 1895.

Victoria, 67 and 68—67, set in 1892. Very vigorous, upright. Wood not well matured. Badly injured in the winter of 1893-4. Present top is from a sprout which started about six inches from the base. 68, vigorous, but not well matured. Growth four feet.

Voronesch Yellow, 93 and 94—A Russian variety, upright, vigorous, hardy. Slow in starting, but now making a vigorous growth. Has not fruited.

Washington, 12—Badly checked when removed from the nursery. Now in good condition. Very vigorous.

Weaver, 53—Set in 1894. Very vigorous, spreading, hardy. The original tree set in 1892 made a very vigorous growth and failing to mature the first year was killed by the hard winter.

Wild Goose, 64—Vigorous grower, but killed back every year. Dead in 1896.

White Nicholas, 97 and 98—97, very vigorous, upright, hardy. A good tree. Black knot found on one side of trunk. 98. bore a full crop of fruit in 1896. The fruit very closely resembles that of Early Red. It is possible that the two varieties were mixed in the nursery.

Wolf, 47, 73 and 74—Set in 1893. Very vigorous, hardy. Has borne no fruit.

Wyant, 77 and 78—77, hardy, vigorous. Fruit buds well developed. Bore small amount of fruit in 1896. Very late. 78, smaller tree than No. 77 because of injury when young.

Yellow Egg, 4 and 5—4, badly checked when removed. Now growing vigorously. Bore a few fruits in 1896. 5. tree injured, one-half dead, the other growing vigorously.

Yellow Transparent, 58—Set in 1893 and again in 1895. Killed both times.

The foregoing notes represent the condition of the plum orchard. The conditions were unfavorable at the time of starting the orchard and there have been many failures. From these failures some valuable lessons have been learned. Most of the standard varieties have proved hardy and are at present in a good thriving condition although few of them have yet fruited.

The Russian sorts have proved hardy and productive, but the quality of those which have fruited is inferior.

Of the varieties which have been found to be too tender for our winter climate we may note: American Eagle, DeCaradeuc, Lone Star, Newman, Osage, Pottawatomie, Robinson, Victoria, Wild Goose and Yellow Transparent.

Of the standard varieties which are especially promising at the present time the following may be mentioned: Duane Purple, German Prune, Hudson River Purple Egg, Imperial Gage, Lombard, McLaughlin, Pond's Seedling, Smith's Orleans and Washington.

When the orchard comes into full bearing, the several varieties will be described more in detail.

II. THE APPLE ORCHARD.—STANDARD VARIETIES.

The nucleus of the orchard consisted of a number of trees set in nursery rows in 1890, before the work came under the direction of the writer. These trees were removed to a permanent location in the spring of 1891 and several varieties were added to the list. The soil on which this main orchard was set is variable, part being a heavy clay loam and part a light sand. Thorough cultivation has been given from the first, the land having been used as a vegetable garden.

The following table represents the present condition of the orchard:

PRESENT CONDITION OF STANDARD VARIETIES OF APPLES.

Name.	Habit.	Present Condition.	Growth in 1896.	Age at first fruiting.
			In.	Ys.
Akin		Young tree, set in 1894.		
Alexander	Upright, vigorous, spreading	Vigorous	15	5
Arctic	Very vigorous, spreading	Strong, healthy	20	6
Astrachan	Upright, vigorous	Strong, healthy	12	5
Chenango	Upright, vigorous	Strong, healthy	12	6
Fallawater	Vigorous, spreading, sturdy.	Strong, healthy	12	
Fameuse	Vigorous, spreading, sturdy.	Strong, healthy	18	5
Haas	Vigorous, spreading, sturdy.	Strong, healthy	15	5
Hurlbut	Moderately vigorous, upright	Strong, healthy	20	5
King of Tompkins	Very vigorous	Strong, healthy	15	
Mann	Moderately vigorous, upright	Weak	12	
Milding	Vigorous, upright, sturdy	Strong, healthy	16	
Northern Spy	Vigorous, spreading	Young tree, set in 1894.	6	
Nor'west'n Greening		Young, set in 1895	15	
Oldenburg	Upright, sturdy	Strong, full bearing	15	4
Peck's Pleasant	Low, spreading	Weak	10	
Pewaukee	Very vigorous, spreading	Healthy	18	5
Porter	Moderately vigorous, low, spreading	Healthy	16	
Princess Louise	Vigorous, upright	Healthy	18	5
Red Beitigheimer	Upright	Weak	6	5
Rolfe	Moderately vigorous, upright sturdy	Strong	10	
Shiawassee Beauty	Very vigorous, spreading	Strong	15	6
Stark	Vigorous, upright, spreading	Strong	12	
Thompson No. 24	Vigorous, upright, spreading	Strong	18	
Thompson No. 26	Vigorous, upright, spreading	Strong	24	
Thompson No. 29	Vigorons, upright, sturdy	Strong	12	
Thompson No. 43	Vigorous, willowy	Strong	12	
Wagener	Moderately vigorous	Strong	10	
Walbridge	Upright, vigorous, spreading	Strong	12	
Wealthy	Upright, vigorous, spreading	Strong	15	4
Westfield	Moderately vigorous	Strong	12	
Winesap	Vigorous, spreading	Strong	15	5
Wolf River	Vigorous, spreading	Strong	18	
Yellow Transparent	Vigorous, spreading	Blighted	6	

The number of trees in the orchard at present is 130, about 30 having been removed on account of a new building. Of this number ten varieties are crabs, and the remainder, 34 varieties, consists mainly of standard varieties of recognized merit. The object in view in starting the orchard in this way was to have a number of the standard sorts for comparison. Many of these will be top-worked with other varieties.

With few exceptions the trees have thrived and proved hardy, although neither soil nor location are well suited to orcharding. Several sorts bore some fruit last season, and the present year many others came into bearing. Most of the varieties in this orchard are well known and require no special mention. Some of those not commonly grown may, however, be noticed in this connection.

Arctic—Tree very vigorous, upright, spreading. Fruit medium, roundish conical; greenish yellow, heavily overlaid with crimson on the sunny side, with splashes of a deeper shade and numerous light dots. Flesh yellowish, crisp, juicy, brisk sub-acid. Good. Bears a strong resemblance to Baldwin and will replace that sort in trying climates. The following notes from Mr. W. A. Taylor of the United States Department of Agriculture are of interest in this connection: "So far as we have been able to ascertain the original tree of Arctic apple was found growing on the farm of John H. Esseltyne, Cape Vincent. New York. Mr. Esseltyne sold the tree some years ago to O. K. Gerrish then of Geneva, N. Y., but now of Lakeville, Mass. After securing a crop of wood for propagation Mr. Gerrish destroyed the original tree to prevent theft of scions. It was therefore impossible to secure specimens of the fruit for examination after the variety was introduced by Mr. Gerrish until the trees sold by him came into bearing. In 1896 the variety bore in New York, Massachusetts, Vermont and Maine, as we received specimens from those states. We consider it a promising variety for market orchards in the north as it is apparently more resistant to the cold than Tompkins King or Baldwin."

Haas—A popular market variety from Missouri. Tree hardy, very vigorous, upright, productive; an early annual bearer. Fruit medium, oblate or slightly conical; skin smooth greenish yellow, shaded nearly over the whole surface with dark red. Flesh white, tender, juicy, brisk sub-acid. September, October.

Haynes' Sweet—A very vigorous, hardy sort, originating in Waldo county, Maine. Fruit large, oblong, yellow, washed and splashed with scarlet. Stem short, stout, in a broad, shallow, slightly russet cavity. Calyx open; basin shallow, slightly irregular; core very large. Flesh rather coarse, yellowish, sweet. Good. September to January. This variety is perfectly hardy and vigorous as far north as Caribou. Its color is not bright enough to make it a valuable market sort.

Milding—A strong, hardy variety, originating in New Hampshire. Highly esteemed in Piscataquis county and wherever known. Fruit large, oblate, whitish-yellow, shaded, splashed and mottled with red; flesh light yellow, rather coarse but crisp, tender, juicy, sprightly sub-acid. December, January.

Munson Sweet—A vigorous productive variety of uncertain origin. Fruit medium, oblate, pale yellow often with a blush. Flesh yellowish, juicy, sweet. Highly esteemed wherever known. September to February.

Pewaukee—A seedling of Oldenburg, originating in Wisconsin. Tree hardy, vigorous, upright, spreading, an annual bearer and very productive. Fruit medium to large, roundish. Skin yellow splashed and mottled with red. Flesh white, juicy, brisk acid. Good for cooking. November to February.

Prolific Sweeting—One of the varieties imported from Russia by the Department of Agriculture in 1870. It is a beautiful yellow fruit of medium size. Somewhat resembles Yellow Transparent in form and color. Of this variety Dr. Hoskins writes: "It is the best fall sweet apple I am acquainted with, and I could sell almost unlimited quantities of trees and fruit if I had them. I am now propagating it on a large scale for my own planting." Season September to October.

Rolfe—A valuable early winter variety, originating at Guilford, Me. Tree hardy, vigorous, a good annual bearer. In protected places will thrive as far north as Caribou. Fruit medium to large, oblate, yellowish, shaded and splashed with red. Flesh white, fine grained, tender, sub-acid. December, January.

Shiawassee Beauty—Seedling of Fameuse, originating in Shiawassee county, Michigan. Larger and more oblate than Fameuse, otherwise resembling that variety. Flesh firm, white, tender, brisk sub-acid. October to January.

III. THE APPLE ORCHARD—RUSSIAN VARIETIES.

As stated in a former Report, one feature of our orchard work is the introduction of hardy fruits.

In the spring of 1890 about 75 varieties of Russian apples were procured from the Iowa Agricultural College. Other varieties of apples have been obtained from time to time and many Russian and native plums and other hardy fruits have been added. Some of these trees have been grown at the College, others were sent to different points in Aroostook county and still others to Rangeley. A few of them have fruited and may receive attention at the present time; a general discussion of the subject being deferred till our next Annual Report.

The following field notes represent the condition of the Russian orchard at the Station in September, 1896. This orchard was started in the spring of 1890, with one year old trees obtained from the Iowa Agricultural College.

The soil in which the orchard is located is rather heavy loam with clay sub-soil. It has a southwestern exposure. Garden crops have been grown on the land from the first and thorough cultivation has been given.

Without reference to the character of given varieties the trees are here arranged in alphabetic order. The numbers enclosed in parentheses refer to the original importation list; the other numbers, to the orchard record.

Alexander, 7—Old tree. A well known sort needing no description at this time. Belongs to the Aport family.

Aport (252), 39—Similar to Alexander in tree and fruit. Growth one and one-half feet. First fruited in 1895. Moderately productive. The term Aport is a generic rather than a specific one and covers a family of apples of which the Alexander is perhaps, the best known member.

Aport Ourent, 21—Upright, vigorous, spreading, with dark heavy foliage. Growth one and one-half feet. No fruit.

Arabskoe, 65 and 66—65 moderately vigorous, spreading; very productive, precocious. About one-half bushel was removed in August and the yield at harvest time was one bushel. Growth one foot. The fruit is large, heavy and covered with a rich bloom, somewhat resembling Blue Pearmain. Keeps well into the winter but is of very poor quality. 66, young tree set in 1896. Has made but a slight growth. Matures late. Growth two feet.

Arabka (*257*), 44—Moderately vigorous, upright, spreading. Dark in wood and foliage. Growth one and one-half feet. Fairly productive. Has a tendency to bear the fruit on the ends of long twigs like the Alexander. Same as Arabskoe.

Blushed Calville, 31—Of vigorous, upright habit, resembling Yellow Transparent. Growth one and one-half feet. It so closely resembles Yellow Transparent that its identity is questioned.

Borsdorf (*356-402*), 46—Vigorous, spreading, profusely branched. Branches small and slender. Light colored in wood and foliage. Growth two feet. A few specimen fruits produced in 1896. These are small, oblate, greenish yellow. Mature in late winter.

Cross Apple (*15 M*), 28—Very vigorous, upright, spreading. Branches freely. Limbs long and slender. Growth this year two and one-half feet. Moderately productive. Fruit resembles Haas. This variety does not correspond with the description of Cross Apple as given by various authorities and it is possible that it has been misnamed.

Daisy, 60—Two-year-old tree set in the spring of 1896, making a strong growth.

Early Sweet (*No. 9 Voronesch*), 8 and 52—Vigorous, upright, spreading. Large, heavy foliage. Growth one and one-half feet. No fruit.

Excelsior—One of Gideon's Seedlings. Vigorous, spreading, productive. Like the preceding and like the next one, shows the crab parentage. Wood fully matured. Growth one and one-half feet. Full crop of fruit. Fruit medium, conical, greenish-yellow washed with crimson, slightly russeted. Sharp acid. September to November.

Golden Reinette, 20—Vigorous, upright, spreading, productive, (one and one-half bushels fruit). Branches freely with tendency to form crotches. Fruit small, golden, washed and splashed with carmine. Flesh yellowish, crisp, mildly acid. A promising autumn variety. September to December. (This fruit does not correspond to Budd's description of Golden Reinette and is probably wrongly named.)

Grandmother (*469*), 50—Vigorous, upright, hardy. Growth two feet. But one fruit produced in 1896. Resembles Duchess. Season winter.

Green Crimean (*399*), 48—Vigorous, spreading and productive. Branches freely. Growth one foot. First fruited in 1896. Fruit large, smooth, conical; green, changing to yellow at maturity. A good autumn variety.

Green Sweet, 37—Wrongly named. A small sour winter fruit of no value.

Hibernal (*378*), 47—Of low spreading habit, moderately vigorous. Productive. Growth one foot. First fruited in 1894, (one-half bushel in 1896). Drops badly at maturity. Good for cooking. Season October and November.

Koursk Anis, 13—Set in 1895. Hardy. Moderately vigorous. Growth one foot.

Koursk Reinette, 30—Vigorous, sturdy in habit with few stout branches. Large dark foliage. Growth one and one-half feet. Productive. A promising variety. This variety we have as 20 M. The latter is by Mr. Budd, called "Sweet Longfield."

Large Anis (*413 Dept.*), 54—Moderately vigorous, spreading branches. First fruited in 1896 (one-fourth bushel). Growth one and one-half feet. Fruit resembles Rhode Island Greening.

Lead Apple (3 *M*, *277*), 23 and 41—23, vigorous, spreading; branches leave the trunk nearly at right angles, so few crotches are formed. Growth one and one-half feet. Productive (one and one-half bushels in 1896). The variety which we have under the above name is apparently of the Aport family and is not the true Lead Apple as described by Budd. 41, (*277*), very vigorous, upright, compact, few branches, has a tendency to form crotches. Growth one and one-half feet. No fruit. It is possible that when this comes into bearing we shall find that we have the true Lead Apple, although in Bulletin No. 31, Iowa Agricultural

College, Professor Budd refers to No. 277 as *Swinsovka*, a member of the Lead Apple family but not identical with 3M, the true Lead. Further study is evidently necessary.

Longfield (*161*), 36—Vigorous and very productive. Growth two feet. Fruit of medium size, conical, yellow with red cheek. Good for cooking and for dessert. Season September to January. In common with most of the Russian varieties, it drops badly and must be harvested early. Valuable.

Losovka (*4 Orel*), 1—Tree in rather a low situation, badly broken by snow and careless workmen in 1892. Recovered and making a vigorous growth at the present time. Foliage thick and leathery. Of vigorous spreading habit. Growth the present season two feet. No fruit.

Mallett, 14—Upright, compact, vigorous with few branches. Growth two and one-half feet. No fruit.

October, 81—One of Gideon's Seedlings. Moderately vigorous, spreading; few branches; very productive (one and one-half bushels in 1896). Wood well matured. Growth one foot. Fruit small, conical, yellow, washed and splashed with carmine. Flesh white, crisp, acid. A handsome fruit, good for cooking.

Orel No. 7, 3—Very vigorous, spreading. Foliage thick, heavy, resembling Losovka in this respect. Growth two feet. No fruit.

Ostrakoff (*4 M*), 24 and 33—24, vigorous, upright, spreading, with few stout branches and heavy dark foliage. No fruit. 33, young tree set in 1896.

Peter, 79—One of Gideon's Seedlings. Moderately vigorous, spreading; very productive. The habit of the tree as well as the character of the fruit shows the crab parentage. Wood well matured. Growth one foot. Bore a full crop of fruit in 1895 and 1896.

Red Queen (*316*), 45—Upright, sturdy, compact, with few branches. Bore a few specimen fruits in 1896. These were conical, greenish-yellow with blush cheek. Season winter. It is questionable whether this is rightly named.

Repka Aport (*261*), 40—Resembles Alexander. Produced a full crop of fruit which checked the growth to a certain extent. Growth one foot.

Repka, 5—Young tree set in 1896. Growth six inches.

Russian Gravenstein, 35—Very vigorous and spreading. Productive. A promising autumn fruit of about the season of Duchess, which it somewhat resembles.

Sandy Glass, 32—Upright, sturdy with handsome dark foliage. Growth one foot. A second growth started late in the season. But two fruits were produced.

Saunkernaty, 18—Very vigorous, spreading, branches numerous. Foliage small, but thick and with a heavy pubescence. Fruited for the first time in 1896 (one-half bushel). Fruit small, green, of fair quality. Season winter. May be of value in the north.

Silken Leaf (*75 M*), 34—Vigorous, spreading, dark in wood and foliage. Moderately productive. Growth two feet. Fruit small, conical, greenish-yellow overlaid with red.

Sklanka, 16—Very vigorous, upright, hardy. Growth two feet. No fruit.

Skruischapfel, 17—Very vigorous, upright and compact. Branches few and stout. Hardy and productive. Three pecks of fruit this year. Fruit small, of poor quality and drops badly.

Striped Winter, 11—Moderately vigorous, spreading. Light colored in wood and foliage. Growth one and one-half feet. No fruit. Inclined to make a second growth in autumn.

Sweet Pippin (*5 Orel*), 2—An upright, vigorous grower. Foliage smaller and thinner than the preceding. Average growth two feet. No fruit.

Swinsovka, 4—Moderately vigorous, upright, spreading; broad thick leaves of moderate size. Growth one foot. No fruit.

Table Apple, 19—Very vigorous, spreading, branches freely. Foliage thick, leathery, and densely pubescent on under side, of characteristic dark bluish-green color. Growth two feet. Single specimen of fruit produced in 1896. Small, roundish, oblate, green, stalk short, slender in narrow cavity. Calyx small enclosed in a broad shallow basin.

Tiesenhausen, 38—Upright, sturdy, vigorous, productive. Growth two feet. Fruit small and worthless for New England.

Tetofsky, 75 and 76—75, young tree set in 1895. Vigorous, upright, compact. Few stout branches. Very large leathery foliage. 76, the identity of this tree is doubted. We shall give description later.

Titovka, 69—Very vigorous, upright; has a tendency to form crotches. Few but stout branches. Growth two feet. No fruit.

Titus, 10—Very vigorous, spreading, shoots stout and dark colored. Foliage large, thick and leathery, with heavy pubescence on the under side. Growth one foot. First fruited in 1896 when two specimens were produced. Fruit very large and showy, but coarse grained.

Ukraine (*290*), 42—Upright, vigorous, compact, hardy and productive. Growth one and one-half feet. The fruit is large and handsome. Season September. Good for cooking.

Vargulek (*12 M*), 26—In habit of growth like the preceding. Inclined to form crotches. Rather slender for the heavy load of fruit (one and one-half bushels in 1896), which checked the growth somewhat. Growth one foot. Fruit small to medium, greenish-yellow with stripes and splashes of crimson. Quality good. Drops badly.

38 Voronesch, 53—Moderately vigorous, upright, spreading. Few branches. Growth one foot. Very productive. Fruit of Duchess type, but two weeks earlier.

50 Voronesch, 54—Vigorous, upright, compact. Branches long, but stout. Growth one and one-half feet. No fruit.

Wealthy, 68—Low, vigorous habit. Very productive (two bushels fruit in 1896). In spite of heavy crop made a growth of one foot. This is the best of the seedlings sent out by Peter M. Gideon of Minnesota.

10 M, 25—Very vigorous, upright, compact, with comparatively few but stout branches. Growth one and one-half feet. Very productive, but the fruit drops badly. Season September. Fruit small, conical, greenish-yellow with splashes of red; of poor quality.

13 M, 27—Vigorous, upright, compact, with dark heavy foliage. Growth one and one-half feet. No fruit.

18 M, 29—Upright, spreading with numerous long slender branches. Growth one and one-half feet. No fruit.

984, 51—Moderately vigorous; spreading, few branches. Growth one and one-half feet. No fruit.

387, 12—Moderately vigorous, spreading. Removed to present location in 1892. Growth one and one-half feet. No fruit.

Of the varieties above mentioned the following are at present regarded as most promising: Aport, Arabskoe, Golden Reinette, Hibernal, Lead Apple, Longfield, Russian Gravenstein, Vargulek.

The Gideon Seedlings, Excelsior, October and Peter are very productive and good for cooking but are not specially valuable save in the colder parts of the State.

IV. ORCHARD WORK IN AROOSTOOK COUNTY.

In the spring of 1890 fifty varieties of Russian apples were sent to E. W. Merritt, Houlton, and a duplicate lot to J. W. Dudley, Mapleton. The lot sent to Mapleton was divided, one-half being placed with Edward Tarr. All of the trees sent to Mapleton were placed in nursery rows till they should fruit.

Trees placed with E. W. Merritt—Mr. Merritt set his trees in a young orchard, and has given them good care up to the present time. Some of the varieties have fruited abundantly and proved of considerable value. The following table gives Mr. Merritt's observations concerning such of these trees as have fruited.

MR. MERRITT'S NOTES ON RUSSIAN APPLES.

VARIETY.	When set.	Habit of growth.	Average yearly growth in feet.	First bore fruit.	Present condition.	Productiveness	Quality.*	Season.
Anisim	1890	Very vigorous	1	1896	Good	7	1st,	L. W.
Anthony	1891	Good	1	1896	Good	9	1st,	L. W.
Aport	1890	Very vigorous	½	1896	Good	4	3d,	E. W.
Aport Seedling	1890	Poor	½	1896	Good	5	3d,	E. W.
Aport Virent	1890		½	1896	Good	4	2d,	E. W.
Arabskoe	1890	Upright	1	1895	Good	9	1st,	L. W.
Blackwood	1888	Vigorous, upright	1	1895	Good	5	2d,	Fall.
Golden Reinette	1890		1	1896	Good	8	1st,	L. W.
Golden White	1888	Medium, upright	1	1895	Good	5	3d,	L. F.
Hibernal	1890	Vigorous	1½	1895	Good	6	3d,	L. W.
Koursk	1890	Good	1	1896	Good	6	2d,	L. W.
Koursk Reinette	1890	Vigorous	¾	1895	Good	8	1st,	E. W.
Lead	1890	Good.	1	1896	Good	6	1st,	L. W.
Longfield	1890	Good	1	1895	Good	10	1st,	L. W.
No. 5 Orel	1890	Vigorous	¾	1896	Good	8	1st,	L. W.
Ostrakoff	1890	Very vigorous	1	1896	Good	7	1st,	W.
Silken	1890	Good	1	1895	Good	7	3d,	E. W.
Switzer	1888	Vigorous, spreading	1	1895	Very Good	7	2d,	Fall.
Titovka	1888	Very vigorous, upright	2	1894	Very Good	9	1st,	Fall.
Vargulek	1890	Good	1	1896	Good	5	3d,	E. W.

* Quality in this table is but relative. Those ranked as first quality are but second when compared with standard sorts. Abbreviations: F—fall; W—winter; E—early; L—late.

Concerning the above list Mr. Merritt writes: "I do not consider any worth propagating unless the tree ranks seven in productiveness and the fruit one in quality. The quantity is indicated more particularly with reference to use for dessert purposes. The trees mentioned in the table are all hardy, and good growers, but some of the trees sent have not come into bearing and are poor growers. Some seemed determined not to grow and have been replaced with trees of approved varieties."

Trees Placed With J. W. Dudley—Many of the varieties sent to Mapleton have already been described in the notes on the Experiment Station orchard. The two lots, however, are not quite comparable, since the trees at the Experiment Station have received more thorough culture and are not crowded into nursery rows. Because of the more vigorous growth of the former, fruiting has in some cases been delayed.

The following notes represent the present status of the trees entrusted to Mr. Dudley:

Aport (252)—Vigorous, upright, spreading. In habit of growth and in fruit resembles the Alexander. First fruited in 1896 (a few specimens). As before remarked, the term Aport applies to a family of apples which includes the Alexander and some other varieties.

Aport Ourent.—There is some doubt as to the identity of this variety. The tree is very vigorous and productive. Fruit large, handsome and promising and will receive further attention.

Arabka, (No. 257)—Broken over by snow several times. At present about the size of a good two-year-old tree and now vigorous.

Arabskoe—Hardy, healthy, vigorous. First fruited in 1896 (one half bushel). Worthy of propagation.

Bogdanoff—Tree upright with thick leathery foliage. First fruited in 1896. Fruit large, smooth and highly colored. Good. Season winter.

Borsdorf, (356)—Upright, vigorous, spreading. First fruited in 1896 (a few specimens).

Cross Apple, (No. 413)—Moderately vigorous, light colored in bark and foliage. First fruited in 1896 (one-fourth bushel).

Golden Reinette—Moderately vigorous and spreading. First fruited in 1895 (one-fourth bushel). The fruit is much smaller than on the tree in the Station orchard.

Grandmother, (No. 469)—Badly injured by the snow in 1891. Recovered and though a small tree, bore some fruit in 1896. Resembles Vargulek.

Green Crimean, (No. 399)—Injured by snow in 1891, but recovered and is now making a moderately vigorous growth.

Limbs have a characteristic horizontal growth. Its habits do not correspond with the habits of the Green Crimean as described by Professor Budd.

Green Sweet—Injured by snow in 1891. Now making a vigorous spreading growth. Has not yet fruited.

Lead Apple, (No. 277)—Vigorous, upright, with few stout branches. Twelve to fifteen inches growth. Has not fruited.

Losovka, (No. 4, Orel)—Vigorous, spreading, with thick leathery foliage. Blossomed in 1896, but no fruit matured.

Red Queen, (No. 316)—Injured by snow in 1891 and 1892. Now making a very vigorous growth. Resembles Tetofsky in habit.

Repka Aport, (No. 261)—This variety was evidently killed and a sprout from the stalk has been allowed to grow.

Rolfe—This variety, seven years from the bud, bore one-half bushel the present season and has proved vigorous and hardy from the first. It is in a somewhat protected situation, but promises well for Aroostook county.

Silken Leaf (75 M)—Vigorous, spreading. Fruited in 1895 and also in 1896. Promising.

Titus—Very vigorous, spreading, with few stout branches and large leathery leaves. Blossomed in 1896 but matured no fruit.

Vargulek, (12 M)—Broken by snow in 1891. Now making a moderately vigorous, upright growth. First fruited in 1895. The fruit is small, rather showy, but very acid and is not of special value.

38, *Voronesch*—Vigorous, upright, spreading, with thick foliage. Fruited in 1895 and also in 1896. Resembles Duchess, but two or three weeks earlier.

50, *Voronesch*—Moderately vigorous, spreading, with long willowy shoots. First fruited in 1896 (one-half dozen specimens).

20 M—A vigorous, upright tree. Bore fruit somewhat similar to Duchess. Evidently wrongly named.

No. 378—Vigorous, upright. Injured by snow in 1891 and 1892 and has never fruited.

Trees Placed With Edward Tarr—The most promising varieties in Mr. Tarr's collection are the following:

Early Sweet—Vigorous, upright, spreading. First fruited in 1896 (one-half bushel). Fruit of medium size, yellow, juicy, sweet. Valuable for the north.

Revel Borsdorfer—Very vigorous, spreading, hardy, productive. Resembles King in habit of growth. Fruit large, conical, yellowish-white, washed and splashed with carmine. Flesh crisp, agreeably acid. Good. Season late autumn and early winter. Very promising.

Royal Table—Very vigorous, upright, spreading, productive. First fruited in 1894. One and one-half bushels in 1896.

Russian Gravenstein—Very vigorous, upright, spreading, with heavy dark foliage. Fruit medium, conical, ribbed, yellow splashed with red, calyx large, closed, in a shallow, irregular basin. Stem one and one-half inches, stout and rather deep cavity. Flesh rather coarse, white, crisp, tender, juicy, brisk sub-acid. Good. Season September. As grown in Aroostook county this variety is some two weeks later than at the Station and the fruit is smaller.

Striped Winter—Vigorous, upright, spreading. Branches sparingly. First fruited in 1894; one-half bushel in 1896.

Other varieties in Mr. Tarr's collection which are of more or less value are: Anis, Antonovka and Mallett.

Orchard Work at Perham.—As stated in a former report* arrangements were made in 1891 by which a large number of varieties of fruits have been sent to the farm of Mr. James Nutting, Perham, Aroostook county. Mr. Nutting died in 1893, but the work has been continued, under the supervision of the writer, by Mr. Oliver Y. Nutting, to whom much credit is due.

The cions set in bearing trees in 1891 made a vigorous growth and most of them have borne some fruit. The close planting and rank growth of the Duchess trees used as stocks have, however, seriously affected the size and quality of the fruit. Aside from the question of hardiness, therefore, the value of many of the different varieties can not as yet be stated.

In 1892 cions of sixteen varieties were crown, grafted on Duchess seedling stocks. Others were added the following year. In 1895 all that were of sufficient size (13 varieties) were planted in the orchard and the past season several more were set. At present the young trees are growing finely. The varieties included in the list are the following:

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* Report Maine Experiment Station 1891, p. 97.

Arthur,
Bethel of Vermont,
Duchess Seedling No. 8,
Korsk Anis,
Longfield,
McMahon,
North Star,
Okobena,
Ostrakoff,
Patten's Greening,
Prolific Sweeting,
Shiawassee Beauty,
Titus.

Besides the apples above mentioned there are on trial at present several varieties of plums and cherries, all of which are proving hardy and many of which promise to be of value. The list of plums includes the following Russian sorts: Bessarabian, Early Red, Hungarian Prune, Moldavaka, Voronesch Yellow, White Nicholas, 19 and 20 Orel. In addition to these are Cheney, Rollingstone, Wolf, and Wyant of the Americana class.

The cherries include Griotte du Nord, Orel Sweet and 23 Orel. Mr. Nutting reports as follows on these fruits:

"None of the plums sent by you have produced fruit in such abundance as Mooers' Arctic, but they are not yet as old as the latter.

"The cherries are growing well and all but one bore some fruit last year. Orel Sweet and Griotte du Nord are very promising."

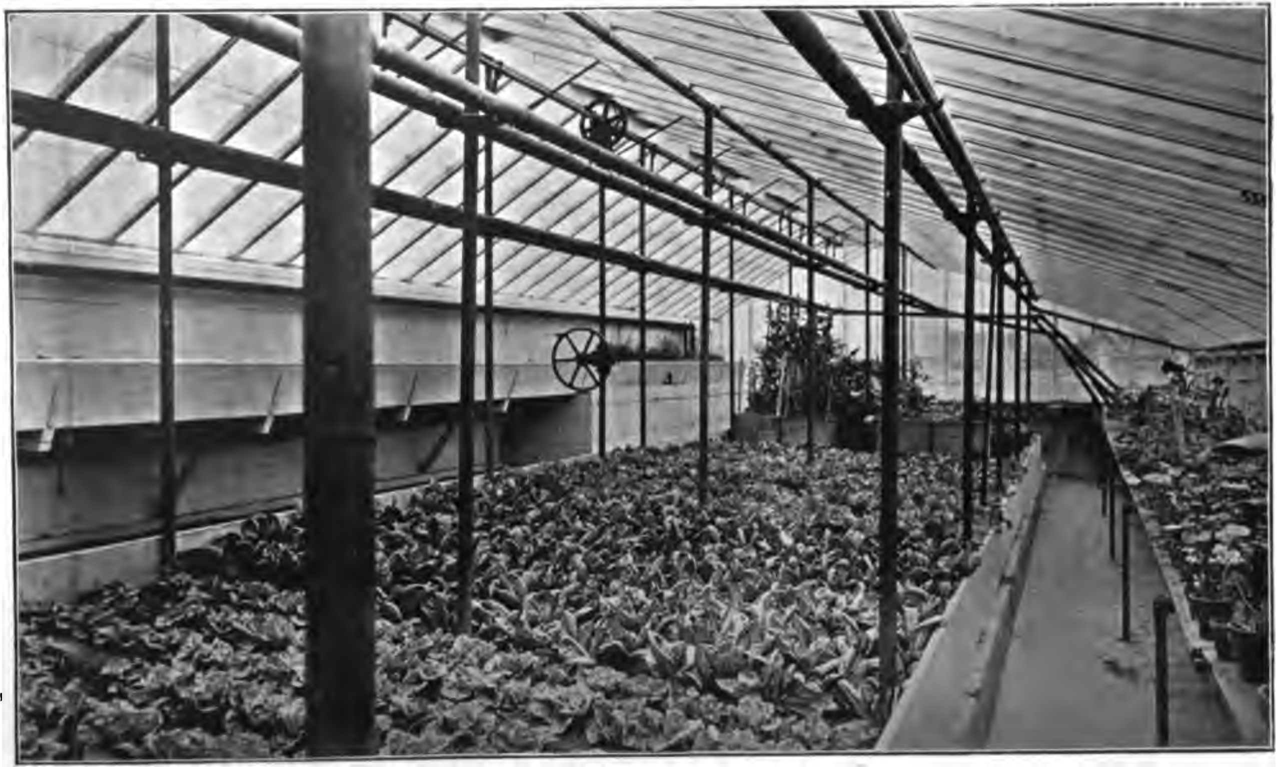
NOTES ON WINTER GARDENING.

W. M. Munson.

Eternal vigilance and the exercise of good judgment, both in the management of the crops and in marketing, are far more important than adherence to set rules in conducting successful gardening operations in winter. The grower must possess a love for the business, and must give personal attention to all of the details. All instructions must be regarded as suggestive rather than as rules to be rigorously applied. These considerations being recognized, and the requisite energy being thrown into the work, the business may be very profitable in many localities.

The risks in forcing vegetables are great. For this reason it is advisable to begin in a small way and develop with the business. One must learn how to ventilate, to water, to manage his furnace, and to market. This experimental work is best done, at first, on a small scale. Again, it will in general be necessary to create a special market for winter-forced vegetables and this must be gradually accomplished. In Maine we cannot hope to compete with the growers of Massachusetts in supplying the large wholesale markets, but must depend upon our own larger cities and towns for a market. For this reason a "fancy" market near at hand should be sought.

Aside from the cost of constructing glass houses, the most important items of expense to be considered are the fuel and the labor. The cost of these items can be only approximately estimated, since they will vary with local conditions. A single house standing alone, covering 2,000 square feet of surface, will require not far from twenty-five tons of coal for the year, if a temperature suitable for tomatoes and cucumbers is to be maintained. For lettuce and radishes considerably less is needed. Several houses standing together will require propor-



LETTUCE IN GREEN HOUSE.

tionately less fuel. In the Station forcing houses, covering approximately 4,500 square feet of glass and an office building, about sixty tons per year are used.

One good man with occasional help should be able to do all the work in houses covering 4,000 square feet of ground if the arrangements are convenient.

I. THE HOUSES USED FOR WINTER GARDENING.

1. *Cold Frames.*

The simplest form of glass structure in common use is the ordinary cold frame. This consists of a box of greater or less extent covered with a sash or sashes. The ordinary sash used in gardening work is 3x6 feet. The cold frame used in commercial operations is made by simply placing boards on edge about six feet apart and laying the sash across them, the ordinary soil of the garden being used. The boards are held in place by driving stakes inside and out and by occasional cross pieces. It is well that one side should be about three or four inches higher than the other in order that the rays of the sun light may be received a little more directly and that the water in case of rain shall run off more freely. For amateur gardens a little more care is usually exercised. A frame twelve to fifteen feet or more in length is made, the back side being twelve inches, the front side nine inches high, with pieces of 2x4 in the corners to hold the boxes together. Sashes are then put across as before indicated. In this way the heat of the sun is utilized in warming up the soil earlier in the spring, and plants may be started several weeks earlier than would be possible in the open ground. Aside from its use in starting early plants the cold frame is little used in "winter gardening."

2. *Hot Beds.*

The hot bed is similar to a cold frame with the addition of some artificial means of raising the temperature of the soil. The usual means employed is that of fermenting manure. In preparing a hot bed, it is well to dig a pit about two feet deep and if a permanent bed is desired, this may be either planked up or bricked up to keep out mice. The hot bed is not practicable for use in midwinter, but may be made as early as March for the starting of early tomatoes, cabbage plants, etc.

In starting a hot bed, fresh, rather strawy manure is used. Horse manure is preferable for this purpose, but sheep manure is sometimes used; that from highly fed animals is best. The manure should be placed in large piles as taken from the stable and turned occasionally to prevent overheating. When the bed is started a layer of manure about six inches deep is placed at the bottom and thoroughly tramped. Then another layer is put in in the same way and so on successively until the pit is full. In case there is not much straw or litter in the manure, alternate layers of leaves may be used to good advantage. This will prevent too rapid fermentation and will make the bed last much longer.

When the pit is filled, a frame similar to the one already described is placed over it and from four to six inches of rich soil are added. The pit for the manure is made about six inches wider than the frame in order that the soil may be heated evenly clear to the edges of the boxes.

In the management of hot beds and cold frames great care is necessary or damage will result from fluctuations in temperature. The volume of air is so small that the atmosphere is quickly affected by outside conditions.

After making the frame a thermometer should be placed within the frame and no seed should be sown until the temperature of the soil has receded to about 80°. In sunny weather constant care is necessary to prevent the burning of the plants. An hour's neglect will sometimes ruin a season's work. It is a good plan to have shades of light cloth to put upon the beds in April and May to avoid this danger. These are best made by tacking pieces of light cotton cloth, which has been soaked in linseed oil, upon wooden frames the same size as the sash. Heavy straw mats are also necessary to protect the beds from cold at night.

Sometimes instead of the single frames described, hot beds are made double, the center being somewhat higher than the sides. In this case, bottom heat is often supplied by means of a flue or hot water pipes instead of fermenting manure. In general, however, for commercial purposes a cheap forcing house is to be preferred to the "fire hot bed," as such a house may be put up at but little greater expense and the cost of maintaining is but little more, whereas the work may be done much more easily and satisfactorily than is possible with the hot bed. In short, a forcing house may be described as a hot bed large enough to get inside of.

3. *The Forcing House.*

a. The Lean-to:—The lean-to or shed-roof house is a natural development of the cold frame or hot bed, and temporary houses may very easily be made by placing ordinary hot bed sash by the side of a wall. This form has the advantage of cheapness in that the sides of a building may be utilized, but it has the disadvantage of allowing light to come in from only one side. A lean-to house should naturally be placed upon the south side of the wall or building.

b. The Uneven-Span House:—The form in most common use at the present time is the so called two-thirds or three-fourths span house. It is similar to a lean-to excepting that the peak has been cut off, thus doing away with a large amount of waste space and allowing more light to come in. In general, houses of this description are placed east and west with the long slope to the south. Recently there has been some discussion concerning the merits of the practice of placing the short slope to the south. The advantages claimed for this practice being that the rays of the sun are much more directly received by the sharper angle; that the snow slides off more quickly; and a third doubtful advantage claimed is that on the north side the long slope will retain the snow to a certain extent and thus shut out cold drafts. The uneven span house is the form almost universally used for the growing of roses and for most commercial purposes. Figure 1 represents such a house at the Experiment Station, which is used for growing lettuce.

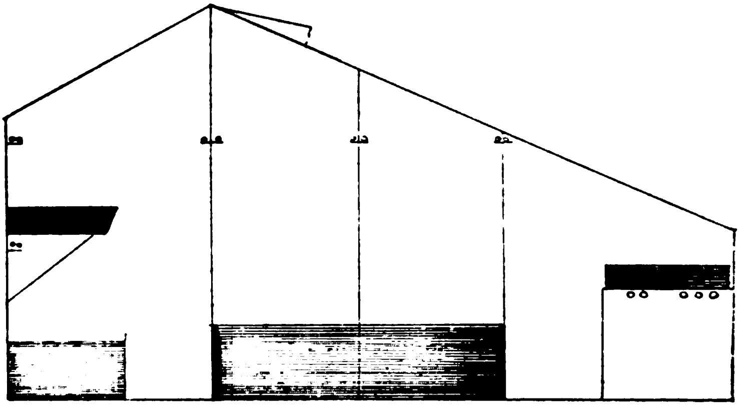


FIG. 1. UNEVEN-SPAN HOUSE.

In making an uneven-span house the angle of the long span with the horizontal is about thirty to thirty-five degrees; that of the short side thirty-five to forty-five, sometimes more.

c. *The Even-Span House:*—This form, figure 2, is used mainly for narrow propagating houses and for conservatories rather than for commercial forcing houses. It is seldom used in a house more than sixteen feet in width. Even-span houses should be placed with the ridge running north and south. They have the advantage of admitting the sunlight on all sides of the plants.

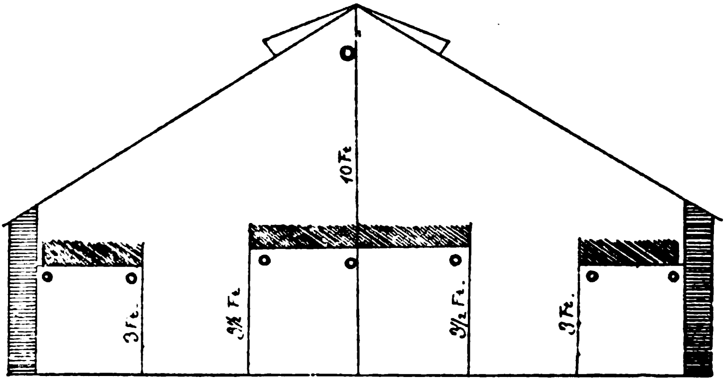


FIG. 2. EVEN-SPAN HOUSE.

4. *Construction of Houses.*

a. Walls and Foundations.—From the nature of the superstructure it is evident that while the foundation of the forcing house need not be specially heavy it must be very rigid. There must be no displacement from lateral pressure nor must there be a possibility of heaving from the action of the frost. If practicable a foundation of cement or stone is desirable, but ordinarily commercial houses are built without such foundation.

The best green house wall is that which at the least expense is perfectly rigid, is durable and will effectually shut out drafts of cold air. A cheap and effective wall is readily made by the use of posts and matched boards. In building such a wall as this, posts are set about four feet apart and in this climate at least four feet deep, that there may be no danger of heaving. The posts should be as uniform in size as possible, about five or six inches being large enough. It is well to place a flat stone in the bottom of the hole before setting the post. A sheet of tarred paper is then tacked on each side of the posts and outside of this the sheathing is placed. Along the top of the posts should be placed a two-inch strip equal in width to the thickness of the posts, and above this the plate. The plate should be about 3x9 inches and bevelled on the top so that moisture may run off readily. It should be grooved on the under side to receive the matched boarding and thus shut off all possibility of the entrance of cold air. It should also have another groove nearer the edge to prevent the backing up of water into the joint formed with the boards. When completed the plate will then project one inch beyond the wall as shown in figure 3.

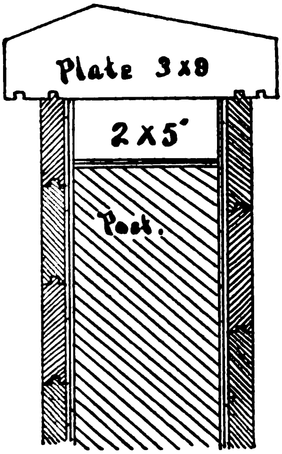


FIG. 3. A CHEAP WALL.

A wall of this description may be built very cheaply and under ordinary conditions will last ten to fifteen years. The posts should of course be selected with care and cedar or locust should be used.

Brick and tile are sometimes used for green house walls. There is always danger, however, that because of excessive moisture and frequent changes in temperature such a wall will not prove durable. The brick wall which appeals to me most strongly is one used by Professor Green of Minnesota.* This consists of a four-inch brick wall on each side of a three-inch hollow tile with a one-inch air space on each side of the tile—thus making a thirteen-inch wall. In this wall we have three separate dead-air spaces, an arrangement from which we should expect excellent results. Such walls, are, however, very expensive and not advised for ordinary commercial purposes.

Some of the houses at the Experiment Station have been built with a double brick wall with an intervening air-space of about two inches. This arrangement is fairly satisfactory provided the brick used are well burned. In any case it is important that the two courses be tied together at frequent intervals.

b. Roofs:—As already indicated, the simplest form of green house roof is made by the use of ordinary hot bed sash. This form has been modified to a certain extent in the building of orchard houses and other like structures with temporary roofs. In such cases a permanent wooden or iron frame is constructed and sash are put in place whenever the houses are desired for use. At the present time, however, some form of permanent sash bar is considered preferable. Sometimes rafters of 2x4 stuff are placed about six or seven feet apart to give rigidity to the roof, but the tendency at the present time is to use rather heavy sash bars and omit the rafters. In this climate, because of the excessive falls of snow to which we are liable, sash bars about 2x2 1-2 inches should be used. Purlins should also be placed at frequent intervals. All supports may best be made of gas pipe or small steam pipe rather than of wood. The object in all of the details of construction should be to shut out as little light as possible. The gas pipe purlins may be made to serve the double purpose of supporting the roof and of carrying the water where desired. This method is followed in some of the larger commercial establishments. It has been suggested that these purlins be utilized in conducting steam for heating, but the advisability of such a practice is questionable because of the alternate contraction and expansion which would follow and the consequent disturbance of the glass. Each sash bar is held in place by means of an iron strap.

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* Bulletin 7, Minnesota Experiment Station.

A ridge pole of 2x5 stuff is generally used. This should be grooved at the sides to receive the glass, as shown in the figure.

c. Glass:—In general it is better to get second quality double thick glass of pretty good size. We prefer 14x22 or 16x24 although because of the lower price on smaller sizes it is common among florists to use 12x15, this being the largest size at the low prices. Belgian glass is more expensive than the American product but is superior to the latter. In some sections heavy plate glass is employed. Of course this latter is very expensive, but it is very durable.

There is a common notion that a flaw or bubble in the glass is likely to serve as a lens and result in burning foliage. Such, however, is not the case as was shown by some very careful work conducted by Mr. J. C. Blair at Cornell University during the past year; but glass of a wavy character or of uneven thickness should be discarded. It is glass of this character that causes the trouble.

5. *Ventilating and Ventilating Machines.*

In general, ample provision should be made for ventilation. The object of ventilation is to purify the atmosphere rather than to lower the temperature and provision should be made whereby the outside air may be admitted near the base of the house as well as at the ridge. The ventilators should extend the whole length of the house, rather than be confined to a few small sashes. It is better to raise the whole line a little than to raise a few sashes to a greater extent, as in the latter case there is danger of injury from cold drafts. Many growers prefer that the ventilators should spring from the ridge, as in this way the warmest air will escape and it is claimed that the house may be kept cooler in very hot weather. In our own experience, however, we prefer to have two lines of ventilators operated independently. In this way, provided the ventilators are hinged at the ridge, we may avoid direct drafts in case of high winds. The ventilating sash should, if possible, be from two to three feet wide and should be continuous for the whole length of the house.

There are several styles of ventilating apparatus, among the more prominent of which are the Hippard, manufactured by E. Hippard of Youngstown, Ohio; and the Challenge, manufactured by the Quaker City Machine Company, Richmond, Ind. The latter has been, perhaps, one of the most satisfactory with us. Another style which we have in our houses is the so called automatic cable ventilator manufactured by A. Q. Wolf & Bro., Dayton, Ohio. This style has the merit of cheapness and thus far has been very satisfactory with us. We have had it in operation for three years. The Rochefort apparatus, now on sale by Henry A. Dreer, Philadelphia, is an English machine which acts on the same principle as that made by Wolf Bros. This has been used but very little in this country. The automatic ventilator, manufactured by the Chadbourne-Kennedy Company, of Poughkeepsie, N. Y., is an expensive machine, costing $50, but with us has proved very satisfactory. An extended discussion need not be given in this connection because it is not likely to be of general use among commercial gardeners. In the extensive houses of W. K. Harris, Philadelphia, the machine is, however, exclusively employed and is regarded very highly.

6. *Methods of Heating.*

Whatever method of heating is used it is well first to consider the cost, the efficiency, the durability and the economy both of fuel and attendance. The method of conveying smoke and other products of combustion through the house by means of brick or tile flues has in the main been superseded by the modern methods of steam and hot water heating. The first cost of flues is certainly light and the fact that they are still used by florists in many parts of the country is sufficient proof of their efficiency, but they are not economical and there is always danger of leakage and the escape of coal gas which is very destructive to plant life. In the large lettuce houses which supply the Chicago markets, however, this method of heating is still very commonly used.

In modern green house heating we have only to consider two general systems—steam and hot water in closed circuits. Each system has its ardent champions; each has its advantages and its faults. Both claim economy of fuel and ease of control as specially strong points. It is claimed that the hot water heaters require less attention than steam heaters. This, however, is a doubtful advantage save at night as frequent attention to the fires is essential to the most economical use of fuel. On the other hand, fewer boilers are required to heat a large plant if steam be used and the first cost of piping for steam is very much less than for hot water. There is no doubt that in the economy of construction and in efficiency, when the circuit is very crooked, steam has the advantage. On the other hand, there is less fluctuation in temperature with hot water.

In selecting a hot water heater, observe the amount and arrangement of direct heating surface, the arrangement of water sections in the heater, the ease of cleaning and the readiness with which leaks may be mended. Horizontal sections are usually most efficient.

For steam heating an ordinary second-hand horizontal flue boiler, condemned for high pressure work, will be found cheap and satisfactory.

7. Pipes and Piping.

The common practice both with steam and hot water at present is to carry the "riser" or flow pipe to the farther end of the house and there distribute heat by means of smaller return pipes. If practicable there should be a gradual ascent in the flow pipe from the furnace to the point of distribution in the returns. There should then be a gradual descent of the return pipes to the furnace. The size of pipe best suited for returns depends upon the length of the coils and also to a certain extent upon their height above the heater. In general, two inch pipe is to be preferred if hot water is used and one inch or one and one-quarter inch with steam. We sometimes use one and one-half inch pipe for hot water circuits, but unless the coils are very short the friction reduces the efficiency of the apparatus.

There has been much discussion as to the relative merits of placing the pipes overhead in the house or under benches. In general, we have found that a combination of the two systems is preferable.

8. *Internal Arrangements and General Management.*

a. Beds and Benches.—There is a great difference in opinion, as well as in practice, concerning the use of shallow benches or of solid beds in forcing houses. In the great lettuce houses of Arlington, Mass., the solid bed is exclusively used, while the famous Grand Rapids lettuce of Michigan is grown entirely upon shallow beds in flue heated houses. In general, however, we would advocate solid beds for plants requiring no bottom heat, such as cauliflower, lettuce, radishes, etc.; while for semi-tropical plants like melons, cucumbers, beans and tomatoes, benches are preferable. Built as they usually are of waste lumber, benches are short lived and must be renewed in from three to five years, but with a little extra care and attention their durability may be doubled. If wooden legs are used, raise them above the level of the soil and place a stone or brick under them. A better plan, however, is to use old steam pipe for legs and allow the pipe to extend to the top of the front boards, thus holding the latter firmly in place.

Another important consideration in making benches in the green house is that a space be left next to the wall that the hot air from beneath may circulate freely next to the glass and that the plants be not injured by cold drip from the roof. If the supports be of wood, it is specially important that paint be used very freely. In all benches provision should be made for drainage by leaving cracks between the bottom boards. Instead of boards, slate or tile is sometimes used. The latter is preferable, but either of these is of course much more durable than wood and is a better conductor of heat. For ordinary purposes, however, wood will probably continue to be mainly used.

b. The Soil:—The soil for use under glass should, as a rule, be more sandy than that usually called "good garden loam." The reason for this is evident. We know that, other things being equal, plants make a more rapid growth and mature more quickly on warm sandy soils than on heavy loams, and it is just this quick growth that we must have in the forcing house. The atmosphere is quiet and is so moist that evaporation is reduced to a minimum in the house, and heavier soils are very liable to become sour or in bright sunny weather to lose their water quickly and become hard and "dead."

A good general rule for forcing house soils is to use two parts of sand, two parts of well rotted manure and two parts of loam from the garden or of turf from an old pasture. Freshly prepared soils will never give satisfactory results in the house. For this reason a large quantity of prepared soil should be kept on hand in a convenient place. Rotted sod is the best basis for green house soils. Our own practice is to get a quantity of sods from an old pasture and place these in layers, grass side down, in a regular stack. Alternating with layers of sod may be placed a liberal quantity of stable manure. The top of the heap should be flat or somewhat concave to retain the rain and hasten decay. Decay may also be hastened by a liberal use of lime while the stack is being made. The heap should be thoroughly forked over after a few months and again at the time of removing to the house. At the second handling any desired amount of sand may be added.

c. The Water:—An abundant and unfailing water supply is essential. Where it is possible to use city water, this will be the best source of supply. Otherwise cisterns must be built or wells provided at considerable immediate expense. Rain water or river water is to be preferred if obtainable, but this is not imperative.

When and how to supply the water is far more important than the source of supply, provided there is no injurious element present. The operation of watering is perhaps the most important factor of green house management. The older a gardener grows the more care he takes in watering, for carelessness in this operation is the exciting cause of innumerable diseases of plants. It is the last operation an apprentice is taught and probably not one man in twenty is thoroughly competent in this direction. In all of the life processes of plants, water is an important factor; but it is well known that plants require very different amounts of water at different seasons, in different situations, or in different states of health.

In applying water we must remember that each plant has an individuality which should be taken into consideration. Transpiration (giving off water) is a physiological and not a mechanical process. It is regulated by the vital action of the plant.

The amount of water depends upon, (1) The kind of plant grown. The native home of a plant may suggest the amount of water needed. For instance, the cactus is a native of the desert and requires but little water, while the tomato is found in a moist region and requires a large amount of water. (2) The conditions as to health and disease. As above mentioned, the vital processes of diseased plants being less active, such plants will utilize less water and will be injured if kept too moist. (3) The nature of the soil. Retentive soils will, of course, require different treatment than will light sandy soils. The former, if given too much water, will very soon become heavy and water-soaked, while the latter will stand very liberal applications. (4) The atmosphere of the house. We must remember that the atmospheric conditions of the house are such that the amount of evaporation is greatly reduced. The plants, too, are thickly crowded together and the ground shaded. These facts will have an immediate bearing on the amount of water to be used at any one time. Naturally in bright sunny days much more water is used than in cloudy weather. Indeed, it is advisable to avoid watering so far as possible on cloudy days.

d. When and How to Water:—In the winter it is rarely advisable to syringe plants or to do much heavy watering in the afternoon as the temperature would be lowered too much, thus favoring the development of fungi. In the summer, on the other hand, it is often advisable to water late in the afternoon in order to reduce the temperature. In general, morning is the best time to apply water, and at this time the walks should be thoroughly wet down to keep the atmosphere moist. In any case the soil should be kept constantly moist. Plants like plenty of water to drink, but will not stand wet feet all of the time.

Whether to apply the water in the form of a spray, wetting both the plant and the surface of the soil, will depend on the kind of crop grown. Roses and other hard wood plants will stand frequent spraying, and it is well to have the surface of the soil moist in the case of melons, cucumbers, etc. Some others, however, thrive best when the surface of the soil is kept dry, so with the latter it is well to force the water to the bottom of the bed in a solid stream, while with the former the thin spray is desirable.

e. The Sunlight:—There is a marked difference in plants, even though closely related, in their ability to stand sunlight. The melon, for instance, will thrive in the strongest sunlight, while the cucumber, which is closely related, also tomatoes and lettuce do better if the roof is slightly shaded during the bright days of spring.

The ill effect of direct sunlight is shown in the "burn" of lettuce and cucumber plants after a few days of cloudy weather. The bright sunlight dries the atmosphere of the house quickly and, according to Galloway, the rapid transpiration causes the breaking down of the tissues. The amount of sunlight is controlled by the use of shades or rollers or more often by painting the roof. A lime white wash applied with a spraying pump is often recommended. This, however, is a temporary expedient as the lime soon washes off. A little salt added to the white wash will greatly increase its adhesive quality. In our own practice we generally use a thin paint of white lead and naphtha, and apply it with a brush. This wash is more durable than the other, is neater, and if not too thick, is readily removed with a cloth or scrubbing brush whenever desired.

f. Insects and Fungi:—The confined atmosphere and high temperature of the green house seem specially favorable to the development of insects and fungous enemies. One of the most common insect enemies is the aphis or green fly, so called. To meet this enemy tobacco smoke is the best weapon. The house should be thoroughly fumigated at least once a week. Trays containing moistened tobacco stems placed upon the steam pipes are sometimes used with good effect.

Snails and slugs are also troublesome. These may best be met by liberal applications of lime and by making traps by placing boards or pieces of potato around in various parts of the house and by hand picking. One of the most common fungicides is potassium sulphide (liver of sulphur) which may be obtained at any drug store. This is applied by dissolving about one-half ounce in a gallon of water and spraying the plants. It is less conspicuous on the foliage than is the Bordeaux mixture and if used in season is very effective in keeping down most fungous diseases. Whenever a plant is observed to be diseased it should at once be removed and destroyed. "Eternal vigilance is the price of success."

II. VEGETABLES GROWN IN WINTER.

In any garden work, and this is specially true of the winter garden, the secret of success is to have something on the ground constantly. It costs but little more to have some plants half grown and ready to take the place of the first crop when marketed than it does to devote the whole house to a crop and then wait several weeks for the next to come on. In case of plants not readily handled, "catch crops" may be grown in the interim.

The most important crops used in winter gardening are: Lettuce, tomatoes, cucumbers and radishes. Besides these staple crops, there are many of minor importance in themselves but which may form important factors in keeping up a succession of crops or in utilizing otherwise waste space. Among these are: Asparagus, bean, cauliflower, cress, parsley, pepper, etc.

Lettuce.

Lettuce is one of the most satisfactory crops for the beginner in greenhouse gardening. It is easily managed; requires a smaller outlay for a suitable house than is necessary for most crops; it is always in demand, and is not a total loss if not marketed within a certain limited time. The plate represents the lettuce house at the Experiment Station as seen in January. The lower bench was at this time devoted to other purposes. It is often used, however, for carrying forward young plants. From three to four months are required for lettuce to attain the best condition for marketing, though with somewhat strong bottom heat we have taken off a crop in ten weeks from the time the seed was sown. So in growing lettuce for the winter markets, the seed for the first crop should be started as early as September 1, and other sowings should be made at intervals of about two weeks to insure a constant supply.

Our own practice is to sow the seed in light, rich soil in flats—shallow boxes about 16x20 inches and two inches deep—and place the flats in a moderately warm and well ventilated room to induce rapid growth. A house kept at a night temperature of about fifty degrees is preferred. When the first true leaves are well started, the young plants are pricked out about 2x2 inches in other flats or in shallow beds. Watering is carefully attended to and the soil is stirred frequently. About a month later the plants are transferred to permanent beds, being placed about 6x6 or 8x8 inches—the distance varying with the variety grown. Many successful growers practice handling twice before the final transfer, placing the young plants two inches apart at the first handling and four inches at the second. With the second and third crops this is, doubtless, a good practice as the main body of the house is thus more fully utilized.

The soil for lettuce should be very rich, light and porous. On solid beds we also place a layer of fresh stable manure before putting in the soil; thus having, in effect, a large hot bed in the house. Before the second crop is put on the bed, the soil is enriched by a liberal quantity of well rotted stable manure.

The quality of lettuce is exceedingly variable, depending largely on the conditions of growth. A good lettuce plant is of rather a yellowish green color and the leaves are thin and brittle. To be of the best quality lettuce must be grown rapidly. The element most important in securing rapid growth of foliage is nitrogen; this element we often apply in the form of nitrate of soda. Place about three ounces—a small handful—of the nitrate of soda in a twelve quart can of water and sprinkle the soil thoroughly. In order that the nitrate be applied at the rate of 100 pounds per acre, each can of water should be distributed over a space about nine feet square (81.6 square feet).

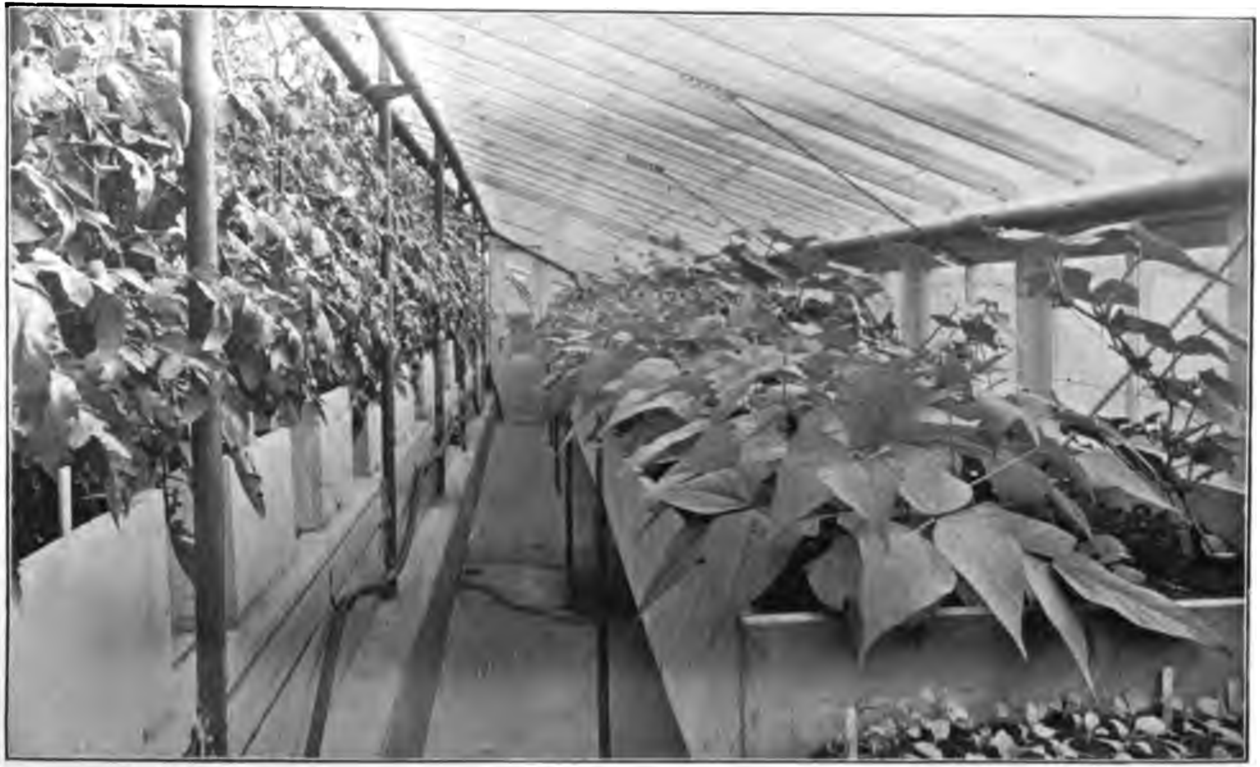
During the earlier stages of growth the plants may be watered freely with a coarse spray; but as the heads begin to form and the leaves cover the surface of the ground, we usually water with a solid stream between the plants. Not infrequently the heading of the plants seems to be hastened by an occasional application of warm water. The marked success of the method of sub-irrigation already outlined will no doubt completely change existing methods. In any case, the atmosphere should be kept moist by frequent spraying of the walks. The leaf surface of the lettuce plant is enormous, and the rapid transpiration in case the atmosphere is very dry will often seriously injure the plants.

The temperature of the lettuce house may be varied considerably, though most growers prefer a night temperature of about forty-five degrees and a range of about twenty degrees during the day. In case it is desired to hold a crop in check for some special purpose, the house may be kept ten degrees lower than here indicated. On the other hand, we often force the crop for a short time by increasing the heat. But, in general, the conditions of temperature should be as nearly uniform as possible.

Insect and fungous enemies must be closely watched. It is a good plan to strew tobacco stems or tobacco dust on the bed among the plants; and thorough fumigation once or twice a week is indispensable. Whenever a plant is affected with mildew it should at once be removed and the use of sulphur on the steam or hot water pipes is recommended. If the soil is stirred frequently, however, and if there is reasonable care in watering and in maintaining a uniform temperature, we are seldom troubled with mildew. One of the advantages claimed for the practice of sub-irrigation is that there is less liability of trouble from disease.

The most profitable varieties to grow will depend entirely on the markets available. In New England there is very little demand for any but the cabbage lettuces, of which there is nothing better than White Seeded Tennis Ball, or a selected strain of this, known as Rawson's Hot House. Of the curled-leaf varieties, Grand Rapids is most popular. The cabbage lettuces are more difficult to grow than the others and usually command a correspondingly higher price.

In marketing, the heads are cut off at the surface of the ground and packed in barrels or crates for shipment. Many



TOMATOES AND BEANS UNDER GLASS.

growers, however, prefer to pull the plants, carefully shaking off all dirt before packing. The demand is best and the prices are highest in February and March, at which time the heaviest crop should mature. In Boston and other eastern markets the prices range from sixty cents to $1 per dozen heads and often higher.

Profits.—Supposing the plants to be set 6x6 inches, we should have four plants per square foot. At sixty cents per dozen this would be twenty cents per square foot for each crop or say fifty cents for the season, as the net proceeds from the house,—a very favorable showing when compared with other crops.

Tomato.

The improved facilities for shipping and the increased extent of the market gardening industry in the South have to a certain extent reduced the demand for hot-house tomatoes; they often bring $1 per pound, however, and seldom in mid winter fall below forty or fifty cents in the Boston markets. In New York competition is stronger and prices are lower, but in most cases the cost of growing and marketing will not exceed thirty or thirty-five cents. Even in the face of southern competition the tomato may be profitably grown, for there is always a demand on the part of some people for the best and the very novelty of hot-house fruit will often count for as much as its unquestioned superiority.*

Cucumber.

The secret of success in growing cucumbers is to have a light, rich soil, good light, strong bottom heat and uniformly high temperature. The ideal house for cucumbers is one which is large enough to allow the vines to attain a good size without interfering with each other; which has rather a flat roof and which will allow ventilation without permitting a draft to strike the plants. A large house is preferable to a small one as the temperature is less quickly affected by outside conditions. As a means of bottom heat, steam or hot water pipes may be used; or if the plants are grown in solid beds fermenting manure is often employed. In our own practice, the plants have been grown in shallow beds heated with steam or hot water.

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* For further notes concerning the forcing of tomatoes see Annual Report Maine Experiment Station 1894, p. 55.

Any time after the first of September the tables may be prepared for the winter crop. A layer of potsherds or "clinkers" from the furnace is first spread upon the table to insure good drainage, then light, rich, fibrous soil to a depth of six or eight inches. No time spent in doing thoroughly the work of preparation is wasted.

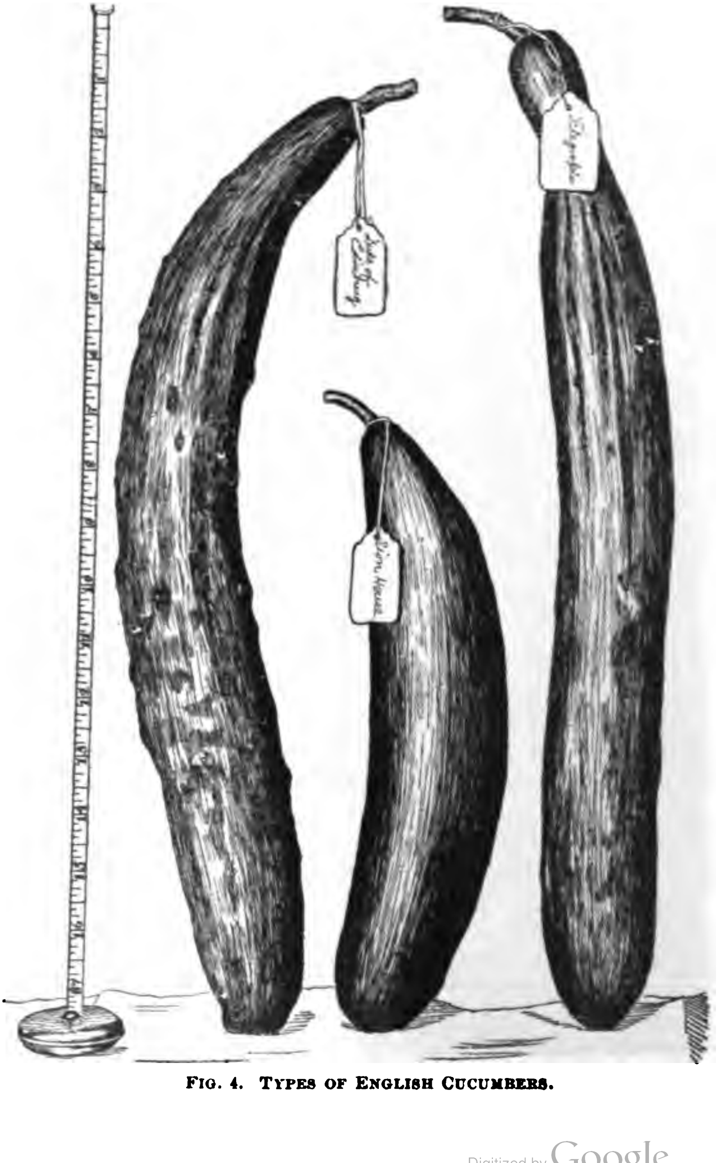


FIG. 4. TYPES OF ENGLISH CUCUMBERS.

The seeds may be sown in the soil where they are to grow or may be started in pots and afterwards transplanted. We usually prefer the latter method. In either case a catch crop may be taken from the bench before the cucumbers are large enough to interfere.

In some sections of the country the English forcing cucumbers are highly prized and it is mainly to this class that attention has been given at the Experiment Station. The cucumbers of this group are very large, varying from fifteen inches to two feet in length, and are practically seedless. The quality is of the best, but the demand for English cucumbers is limited to the fancy trade. Figure 4 represents three of the most popular varieties.

In New England the White Spine, or one of its improved forms, is almost universally grown, and the solid bed rather than the shallow bench is generally used.

As already noted the crop is started any time after the first of September, but the common practice among the larger growers is to raise two and sometimes three crops of lettuce in the house before giving up the space to cucumbers.

About December 1 cucumber seed is sown in a warm house over strong bottom heat. When well started, the young plants are transplanted once or twice to encourage root growth and by the first week in January are in five or six inch pots, and ready for planting out as soon as the lettuce is removed.

Before setting the plants, trenches about one and one-half feet deep and a foot wide are dug about ten feet apart running the full length of the house. These are partly filled with fermenting manure, which should be firmly packed as for a hot bed. The soil is then replaced in the trenches, and the plants set directly over the manure.

The plants are set three and one-half feet apart, two plants at each point for training in opposite directions. Trellises are then made, by placing A shaped supports of iron or wood between each two rows. These supports reach from the bed nearly to the glass and horizontal wires are stretched over them. In this way a V shaped space is left at each row of plants.

The atmosphere should be kept moist and very warm. The temperature should never run below sixty at night and sixty-five is preferable.

Radish.

The radish is among the most easily forced of the vegetables, but in New England markets there is only a relatively small demand for it during the winter. It is best grown as a catch crop—as in the interim between lettuce and cucumbers in spring or between crops of beans—or a single bed may be devoted to this crop in the lettuce house. (See Plate.)

It is usually supposed that the radish demands much the same conditions as lettuce, but in our experience better results have been obtained in a much higher temperature than is suitable for lettuce. The crop must be forced into a rapid and continuous growth in order to secure the fresh, crisp roots that are desired. In rich soil and with sufficient water it is sometimes ready for market in twenty-one days from the seed.

The red turnip-rooted varieties are the ones used mainly for forcing. Of these Cardinal Globe and Non Plus Ultra are among the best. White Box is a favorite in some markets.

An important point to observe in marketing is that the radishes in any given bunch be of uniform size. The wholesale market price will range from $2 to $4 per 100 bunches. A bunch usually takes about eight to twelve roots; varying with the size.

In a general way, as pointed out by Galloway, it is found that about thirty-five per cent. of a given crop of radishes will reach marketable size in thirty-five to forty days, thirty per cent. requiring two to three weeks longer and the rest never mature. Now here is a chance for loss. If the whole crop is taken off when the first plants are mature—as is very desirable—we have no returns from about two-thirds of the ground occupied. On the other hand, if we wait for more of the plants to mature, the next crop is held back fully two weeks and in course of the season this means loss of time sufficient to grow one full crop.

A solution for this difficulty is offered by Professor Galloway of the Department of Agriculture in a very careful study of the relation of the size and weight of seeds to the growth of plants.

In his studies of the radish Mr. Galloway found that, "large seed germinated more quickly and certainly and produced marketable plants sooner and more uniformly than small seeds."

He further concluded:

"(1) By the use of large seed eighty-five to ninety per cent. of the crop may be brought in at the same time.

"(2) Practically all the plants thus grown being marketable no ground is wasted.

"(3) Enough time is saved by using large seed to grow one additional crop during the season. In other words, if four crops are grown, using mixed seed and waiting for plants to attain marketable size, five crops can be grown if large seed is planted.

"(4) The only additional expense is the extra amount of seed used, all the smaller ones being sifted out and thrown away."

This extra expense will average perhaps twenty-five cents per pound of seed. But as one pound will plant about 1,500 square feet of ground, the item is not of great importance.

Beans.

Beans are easily forced and in many places form one of the best secondary catch crops. They are ready for picking in six to eight weeks from the time of sowing and may well be grown on the beds devoted to melons and cucumbers, before the latter need the whole space. The same soil and general conditions described for cucumbers are well suited for the crop.

Beans may be started on the benches where they are to grow, or in pots—two or three beans in a three inch pot—and transplanted in about two weeks. Successive crops are usually started in pots.

Lack of heat in the early stages of growth may delay the crop for a month, so it is not the part of economy to delay heating the house in the fall. A night temperature of about sixty degrees is found best.

Special care is necessary in watering; the leaf surface, and consequently the transpiration of moisture, is enormous and there is danger that the soil may become dry from beneath.

An occasional spraying does no harm, but in general it is best to water with a solid stream and see that the soil is thoroughly wet.

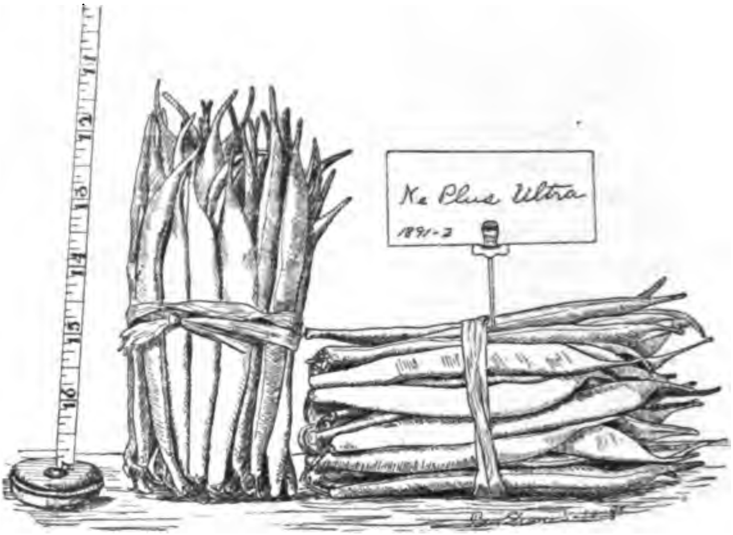


FIG. 5. BEANS READY FOR MARKET.

Growth should be continuous and rapid from the first. A little nitrate of soda, say once a week, after the blossoms appear, will not be amiss. This may be applied in water as described for lettuce.

The crop should all come off within a few days—three or four pickings—so it is important to have the succeeding crop well advanced, that little time may be lost.

The essentials of a good forcing bean are that it should be of compact habit, early maturity, and that there should be an abundance of long, straight cylindrical pods. Sion House is perhaps the best variety for forcing, though Refugee and Ne Plus Ultra have done well. Most of the wax varieties are too unsymmetrical and too susceptible to disease.

For marketing, the pods are tied in bunches of fifty, as shown in figure 5. These bunches should bring fifteen to twenty-five cents each. At this price the crop is profitable.

Asparagus.

This crop is best grown in a portable house, i. e., the roots are planted somewhat more closely than in the field and a temporary house is erected in March to hasten the crop in spring. Sometimes a permanent iron frame is erected and steam pipes are laid about the bed. Glass or canvas is then put on and heat started whenever desired. Such a house is in use at the Cornell University.

An inexpensive modification of this method is sometimes employed. Three rows of asparagus are planted in the ordinary way, the rows, however, being but two feet apart. They are given ordinary field culture till well established. Lines of boards are then set on edge along each side of the bed and hot-bed sashes are laid across, making an ordinary cold frame. The crop may thus be materially hastened, but of course will be later than if supplied with artificial heat. In summer the sashes are removed and the bed is given ordinary open air culture.

The labor and expense of forcing asparagus are light and prices are always remunerative.

Rhubarb.

This crop readily responds to heat and moisture and might well be grown more largely than at present. As usually grown, roots are taken up in the fall and stored till the crop is desired, when they are brought into a moderately warm house and placed under the benches, or in some cases are placed in a "spent" hot-bed. This is a wasteful practice as the roots can be forced but once.

The best plan is that followed in some parts of Massachusetts where a skeleton house is erected, as suggested for asparagus, and provision is made for steam heating. The sides of the house are covered with sheathing or with heavy paper and the sash are put in place whenever it is desired to start the crop. The plants are set two feet apart each way and given ordinary field culture during the summer.

SUMMARY.

Constant watchfulness and the exercise of good judgment are of more importance than adherence to set rules.

A single house standing alone, covering 2,000 square feet of surface, will require about twenty-five tons of coal for the year.

One good man with occasional help should be able to do all the work in houses covering 4,000 square feet of ground surface.

The simplest form of glass structure is the cold frame. Aside from its use in starting early plants it is little used in "winter gardening."

The hot-bed is similar to a cold frame with the addition of "bottom heat."

The uneven span house is the form in most common use. The even-span is used mainly for narrow propagating houses and for conservatories.

The best green house wall is that which, at least expense, is perfectly rigid, is durable, and will effectually shut out drafts of cold air. A cheap and effective wall is made by the use of posts and matched boards.

The glass for greenhouse roofs should be second quality, double thick and of good size—14x22 or 16x24 inches preferred.

The object of ventilation is to purify the atmosphere, rather than to lower the temperature.

In modern greenhouse heating we have only to consider two general systems—steam and hot water in closed circuits.

In general, solid beds are advocated for plants requiring no bottom heat, such as cauliflower, lettuce, radishes, etc.; while for semi-tropical plants like melons, beans and tomatoes, benches are preferred.

When and how to apply water is more important than the source of supply.

There is a marked difference in the ability of plants to stand direct sunlight.

The secret of success is to have something on the ground constantly. The most important crops are lettuce, tomatoes, cucumbers and radishes. Asparagus, bean, parsley, etc., are valuable for keeping up a succession of crops.

NOTES ON PLANTS.

F. L. HARVEY.

Specimens of the following plants have come to the Station from correspondents during the year. The sender has been given the information asked and in some instances the weeds have been made the subject of newspaper articles and bulletins.

WILD PEPPERGRASS (*Lepidium intermedium Gray*) has been reported from many localities this season. It is becoming quite common along roadsides and waste places about towns. Source, western clover seed.

RABBIT-FOOT CLOVER is becoming a common weed along roadsides and in waste places about towns.

VETCH (*Lathyrus palustris.*) Coarse and fine-leaved varieties are very common in Southern Maine along railroad embankments and in car yards. It is spreading.

THE ORANGE HAWKWEED has been reported from several new localities. It should be carefully looked after.

RAG WEED (*Ambrosia artemisiaefolia*) is becoming a common weed along roadsides and in fields. It is an annual and could be easily eradicated with care.

THE WILD CARROT is spreading rapidly in some places. In many localities in the State it is allowed to grow along roadsides unmolested, to scatter seed far and wide.

THE SOW THISTLE (*Sonchus arvensis*) is becoming very common in cultivated fields. Clean culture would eradicate it.

THE GROUND CHERRY (*Physalis Virginiana*) was reported the past season for the first time. The plant probably came from the West in clover seed.

THE BUFFALO BUR (*Solanum rostratum*) made its appearance the last season where carloads of western corn were screened. This plant was considered in a special bulletin.

THE CLOVER DODDER continues to be reported from new localities.

BUTTER AND EGGS is becoming a bad weed in Maine. It usually contents itself by growing along roadsides and in waste places, but this season we saw a field overrun with it. The second crop of seeds had matured after the grain was cut.

YELLOW RATTLE (*Rhinanthus crista-galli*) is becoming a great nuisance in grass lands on the islands along the coast and adjacent sea shores. It is an annual and careful culture would check it. We saw this weed along roadsides at Jackson.

GREEH AMARANTHUS or PIG WEED is one of the most common garden weeds in Maine. It will spring up and perfect its seed after the crops have gone by. It should be pulled in the fall before it seeds.

CULTIVATED RYE appeared as a weed in many fields in Maine the past season. Probably introduced with grass seed. Its tall stalks made it conspicuous and growing as a weed it was not recognized by many.

CULTIVATED FLAX is introduced in western clover seed and it is not uncommon to see the beautiful flowers of this plant in fields.

THE STRAWBERRY LEAF BLIGHT is the most common strawberry fungus in Maine, producing brown spots on the leaves.

THE BLACKBERRY RUST was quite abundant the past season. As this fungus lives over winter in the plants, nothing short of destroying the infected plants before they scatter the spores will eradicate the disease.

PLANTS EXAMINED IN 1896.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	RED BANEBERRY	*Actæa spicata rubra*	A. N. Lufkin, East Orrington.	
2	WILD PEPPERGRASS	*Lepidium intermedium*, Gray.	Fred S. Hayes, Oxford A. N. Lufkin, East Orrington. H. H. Payson, Hope. L. O. Straw, Newfield E. G. Barker, Easton	Weed in fields and waste places. Introduced in western clover seed.
3	SPURRY	*Spergula arvensis*, L.	I. N. Lapham	Weed in grain fields. Sometimes cultivated for forage.
4	BLADDER KETMIA	*Hibiscus Trionum*, *L*	Samuel Libby, Orono	Weed in garden.
5	RABBIT-FOOT CLOVER	*Trifolium arvense*, L.	J. G. Harding, Waldo	Weed in fields and along roadsides.
6	VETCH	*Lathyrus palustris*.		
7	PURPLE FLOWERING-RASPBERRY,	*Rubus odoratus*, *L*	B. W. McKeen, Augusta.	
8	ORANGE HAWKWEED	*Hieracium aurantiacum*	O. S. Overlock, South Liberty, and others.	
9	RAGWEED	*Ambrosia artemisiæfolia*, L.	J. B. Alline, Addison, and others.	In grass fields.
10	YELLOW DAISY	*Rudbeckia hirta*, L	Chas. Plummer, Jr., Charleston.	Weed in cultivated land easily eradicated. From the West.
11	SOW THISTLE	*Sonchus arvensis*, L	B. W. McKeen, Augusta	Weed in cultivated ground.
12	HUSK TOMATO, OR GROUND CHERRY,	*Physalis Virginiana*, Mill.	J. W. Butterfield, East Dixfield	Introduced in western clover seed.
13	BUFFALO BUR	*Solanum rostratum*, Dunal.	E. C. Carll, Buxton	Came up where cars of western corn were unloaded.
14	CLOVER DODDER	*Cuscuta epithymum*, Murr	A. Merriman, Harpswell Center.	Parasite on clover.
15	BUTTER AND EGGS	*Linaria vulgaris*, Mill.	Daniel Lindsay, Carroll	Weed along roadsides and in fields.
16	PUBESCENT BEARDSTONGUE	*Pentstemon pubescens*, Solander	F. E. Bixby, Anson	Weed in cultivated field.

PLANTS EXAMINED IN 1888 CONCLUDED.

No.	COMMON NAME.	TECHNICAL NAME.	FROM WHOM RECEIVED.	REMARKS.
17	YELLOW RATTLE	*Rhinanthus Crista galli*, L.	R. S. Warren, South Deer Isle	Weed on sandy seashore.
18	PIGWEED, GREEN AMARANTHUS	*Amarantus retroflexus*, L.	E. E. Light, Union	Weed in cultivated ground
19	BLACK BIND WEED	*Polygonum convolvulus*, L.	Various parties	Introduced in western grain.
20	CORAL ROOT	*Corallorhiza multiflora*, Nutt.	N. W. Leonard, Thomaston	Sent for name.
21	CULTIVATED RYE	*Secale cereale*	E. E. Paine, Jay L. F. Abbott, Lewiston	Weed in cultivated fields.
22	HUNGARIAN GRASS	*Setaria Italica*	B. W. McKeen, Augusta	For name. Weed in fields.
23	STRAWBERRY LEAF-BLIGHT	*Sphaerella fragariae*, Sacc.	Various parties	Very common in Maine.
24	BLACKBERRY RUST	*Cæoma nitens*, Schw.	F. A. C. Emerson, Garland	Attacking the leaves of living blackberries.
25	PEAR LEAF BLIGHT	*Entomosporium maculatum*, Lev.	W. L. Mace, East Winthrop	Attacking the leaves and twigs of pears, causing them to turn black.
26	....	*Cenangium conspersum*, Fr.	R. C. Fuller, Wilton	Attacking apple trees.

WEEDS AND SEEDS.

That weeds are increasing in Maine is apparent to anyone whose attention has been called to the matter. Scarcely a year goes by without the introduction of some new weed not previously reported from the State. The spread on the farm, or from farm to farm of old acquaintances is of common occurrence.

The weed question has become a serious one to the farmers of Maine. It is a hopeful sign that public opinion is becoming aroused on the subject.

There are several causes for the introduction and spread of weeds, but they are largely under the control of farmers through personal attention and legal enactment.

Weed seeds may get into the State in discarded ballast from vessels; through packing material from other states and countries; on through cars; by migrating birds and other minor sources, although these latter causes are only occasional and accidental. By far the most serious and certain causes are the annual importation of seeds for planting and grain for feed. In later years farmers have grown less grain than formerly and the demand has steadily increased with our growing stock industry. We are more dependant than ever upon other states both for seeds and grain for feeding. With this foreign seed and grain have been introduced the weeds growing in the regions from which they came.

Farmers have not been alive to the importance of not introducing weeds into their fields and have been quite indifferent in regard to the quality of the seeds they have sown and the grain they have fed. They have not seen the importance of destroying weeds in their fields when first introduced; have allowed them to overrun the farm and spread from farm to farm until the fighting of weeds has become a most serious problem. There being no laws against the selling of seeds and grain harboring the seeds of bad weeds, dealers have taken no great pains to offer for sale a quality of seed better than the consumer demanded. Farmers in Maine are largely using a third grade seed when they could get a first grade by paying a little more for it. Dealers say that farmers often from choice take a poorer grade of seed when a better could be had at a few cents more per bushel. We learn that most of the seed sold in Maine is distributed from Chicago and goes through a screening process to get the weed seeds out. It is by no means thoroughly cleaned. That the seed offered for sale could be farther improved and the percentage of weed seeds reduced to a minimum we have no doubt. All farmers have to do is to demand a clean seed and it will be grown. The price would be higher, but it would be much cheaper in the end. We do not believe that a uniformly absolutely pure seed can be grown. Scattering weed seeds must be expected and farmers must be alive to destroying the scattering weeds that appear in their fields the year they seed and the year following. The remedy would be to demand a purer seed and then carefully destroy the scattering weeds that spring up before they spread.

We believe farmers have overlooked grain brought on the farm for feed, as a source of weeds. *We believe more bad weeds are introduced this way than by seeds.* The seed sold in Maine is screened, while that imported for feed is not screened. The latter would naturally harbor more weed seeds, as the cleaner grain is always selected for seed. Grain is scattered where the cars are unloaded and along highways from the centres of distribution to the farm. In feeding on the farm it gets into manure and thence into the fields. We learn from good authority that grain brought in by the carload for feed is sometimes retailed for seed, and that farmers knowingly, to save (?) a few cents, sow such inferior seed. To determine how far grain imported for feed is a source of weed distribution in Maine we addressed a letter to the Maine Central Railroad and received the following reply:

Professor F. L. HARVEY,
Maine State College, Orono, Me.:

Dear Sir,—I have your communication of the 3rd inst., and beg to give you the information that the delivery of cars loaded with western grain is not confined to any one or to a few principal points along our line, but I am sorry to say, for your purpose, that such cars are regularly delivered at every station, though some may receive a larger proportion than others, and such stations I should say would be Portland, Brunswick, Bath, Gardiner, Augusta, Waterville, Auburn, Lewiston, Winthrop, Oakland, Livermore Falls, Farmington, Skowhegan, Pittsfield, Newport, Dexter, Foxcroft, Belfast, Bangor, and on our White Mountain Division like Fryeburg, Brownfield, Cornish, Steep Falls and Sebago Lake.

That western grain brought in by the carloard is often very foul with weed seeds will appear from the following:

One party sent us a *pound* of seed oats from the West, purchased from a local dealer who represented it as cleaned seed and charged several cents per bushel more for it. It was probably unscreened grain from cars. An examination of this seed gave the following results: 1,160 mustard seeds, 576 black bind-weed, 111 goosefoot, 13 smartweed and sorrel, 28 flax seed, 20 grass seeds, several foxtail, 4 wild morning glory, 3 bugloss and several seeds of six different kinds of compositae, not identified.

From another party we received samples of foul seed screened from oats bought for seed. Eight ounces of the foul seed contained as follows: Black mustard, English charlock, jointed charlock, shepherd's purse, pigweed, bind-weed, smartweed, bugloss, flax seed, morning glory, several kinds of grass seed and compositae, and one seed that looked like the Russian thistle.

Samples like the above are not uncommon. We have examined western oats that were fully one-third by weight jointed charlock. The past season a weed new in Maine, the buffalo bur, came up where a carload of western grain was unloaded and screened. Every town where cars are unloaded is liable to become a centre of weed distribution. The only remedy for this is for farmers to use ground feed and not import whole grain.

In the solution of the seed and weed question the following points may be worthy of consideration by the farmers of the State:

1. As far as possible seed grown in the State should be used. Even if such seed be weedy, no new weeds are likely to be introduced. Many farmers grow clean seed on their farms and thus escape the introduction of weeds.

2. Purchase the best the markets afford, as to plumpness, brightness and freedom from weed seeds. If dealers do not keep a satisfactory seed, demand better and it will be provided. It is best to buy early before the rush of planting time.

3. Farmers should watch their fields carefully, especially after seeding, and destroy any new weeds that appear before they seed and spread. This is absolutely necessary, as seed entirely free from weed seeds is not on the market.

4. Farmers should be alive to the importance of clean culture and the necessity of destroying weeds along roadsides, fence corners, hedge rows and waste places. Weeds take the food supply from plants grown for profit, reduce the yield per acre and are themselves worthless. It takes time and money to kill weeds and they yield no return. It becomes an endless job if weeds are allowed to propagate themselves about the fields and annually scatter a fresh supply of seeds. Better strike a blow at the sources of weed seeds. It would be cheaper in the end.

5. Railroad companies should be made responsible for not destroying weeds that spring up in car yards and about depots where cars of western grains are unloaded, and along railroad embankment where weeds frequently spring up from seed brought long distances in ballast or dropped from passing cars. It is unjust that the farming community should suffer from the carelessness of corporations. Towns should be held responsible for allowing weeds to grow in the streets and roads, around lots, and in waste places, to become centres of distribution to farms.

6. Property owners, residents and non-residents should be responsible for harboring weeds along the roadsides fronting their property. This is desirable to protect careful farmers from their shiftless, thriftless neighbors and from weed patches on unoccupied land.

7. As grain brought in by the carload harbors so many weed seeds, the attention of farmers is called to the danger they run in bringing whole grain on the farm for feed.

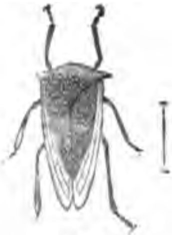


FIG. 1.

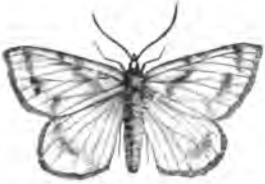


FIG. 2.

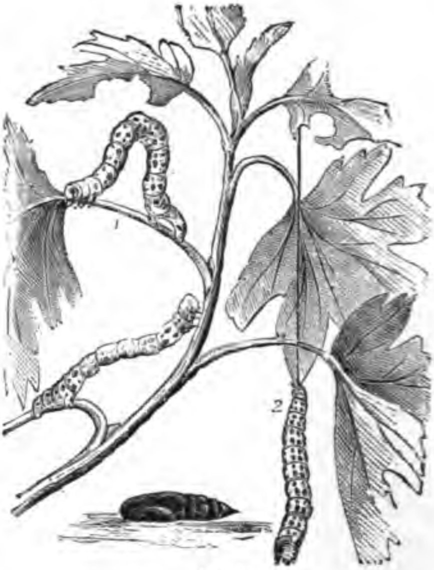


FIG 4.

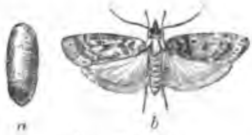


FIG. 3 a & b.

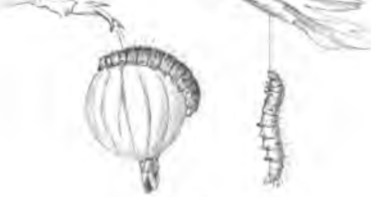


FIG. 3 c.

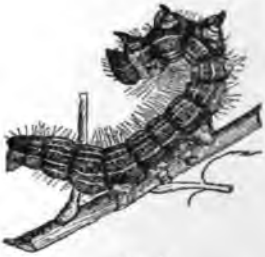


FIG. 5.

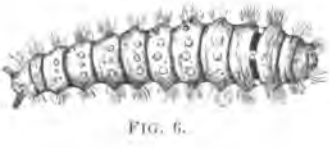


FIG. 6.

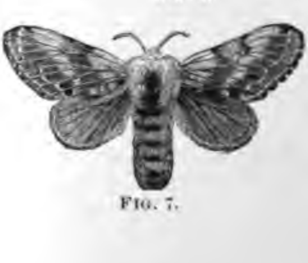


FIG. 7.

NOTES ON THE INSECTS OF THE YEAR.

F. L. Harvey.

Woodlouse or Sow Bug, a crustacean belonging to the genus Oniscus, was reported as doing damage in mushroom cellars by eating the fungi. They can be killed by putting pieces of potato poisoned by a solution of arsenic in the beds.

Croton Bugs were received from Monmouth, Me. These no doubt were introduced in packing materials. This insect is quite abundant in some towns in the State. It is an importation from Europe. They frequent houses especially about water pipes. Free use of insect powder scattered where they frequent is said to destroy them.

The Oyster-shell Bark-louse is exceedingly abundant and is increasing rapidly. As it saps the vitality of trees without attracting much attention, it is overlooked. It seems to thrive better in the North, being worse in Maine than farther south. It does more injury to young trees. We have received information this season of orchards of young bearing trees so badly infested that the twigs of all the trees were literally covered with the scales. The life history of this scale is given in the Report of this Station for 1888, p. 157, but we wish to add the following regarding treatment. The usual way is to apply a dilute alkaline wash to the trees in the spring after the young lice hatch. These scales could be treated in the winter at any time by applying thoroughly to the trees and small branches with a brush a *strong* alkaline wash, made by dissolving two pounds of whale oil soap in one gallon of water. The cost of the material would be more for the strong wash, but there is more leisure in winter to do the work. The strong wash should not be applied after the leaves start.

THE HEMISPHERICAL SCALE was found quite abundant upon ferns grown in the house at Orono. It is also found on ferns in the Station forcing house. It yields readily to treatment with alkaline or kerosene alkaline solutions.

THE ELM-TREE BARK-LOUSE considered in the Report of this Station, 1894, page 83, was reported again this season as abundant on elms.

The elms in Maine are also infested with CANKER WORMS, MOURNING CLOAK BUTTERFLY, THE OAK-BARK WEEVIL and the STEEL-BLUE FLEA BEETLE, (*Haltica chalybea.*)

THE BUFFALO TREE HOPPER was reported this season for the first time as doing damage to the foliage of apple trees. It is pale grass-green in color, marked with whitish dots and a pale yellow streak along each side. It is an active, jumping insect. The form and size are shown in the accompanying plate, Fig. 1.

THE YELLOW-NECKED APPLE-TREE CATERPILLAR was reported this season for the first time as feeding on the foliage of apple trees. The small white round eggs of this insect are laid side by side in nearly straight rows on the under surface of the leaves. The young larvae eat only the pulp of the leaves. When older they devour all but the stem, destroying all the leaves on a branch. The full grown caterpillars are about two inches long. The head is large and black. The joint next to the head is dull orange. There is a black stripe down the back and four yellow stripes down the sides, alternating with three black ones. Body clothed with soft whitish hairs. Fig. 5 shows the caterpillar in the position it assumes (with the head and tail up) when disturbed. Though partial to apple trees, it attacks plums and pears and several kinds of deciduous trees. It is capable of doing great damage when abundant. The larvae feed together and the branch on which they occur can be cut off or the clusters of insects crushed.

THE FALL CANKER WORM so abundant for several years has not been abundant the past season, though doing some damage in southern and western Maine.

THE CURRANT SPAN WORM is very abundant about Orono. Our attention was called to currant and gooseberry bushes almost barren of foliage from the attacks of this insect. It is very different from the Currant Sawfly worm, which is so common in Maine. It is the larva of a geometrid moth, and has the habit common to inchworms of arching the back when crawling. When full grown it is about an inch long, whitish in color, with a yellow stripe down each side and another along the back. The segments are spotted with black. There is but one brood in a season. The larvae have the habit of suspending themselves with a silken thread when disturbed. Fig. 4 shows the larvae, pupa. The moth is shown in Fig. 2. Hellebore will not destroy this insect. Paris green would be effective, but the worms are worst when the fruit is nearly grown. Possibly a strong wash of whale oil soap and water applied in the winter might destroy the eggs which are deposited on the twigs and branches.

THE GOOSEBERRY FRUIT WORM seems to be on the increase. It is common on the wild gooseberries in Maine and may spread from this source. This worm is the larva of a small moth which is shown in Fig. 3 b. The cocoon is shown in Fig. 3 a. The larva, Fig. 3 c. The moth deposits its eggs upon the young berries and the worms gnaw into the fruit. As they grow, several berries are enclosed in a web, and the worms live on them. Infested berries ripen prematurely. When disturbed, the worms let themselves down quickly by a thread, which makes it difficult to destroy them by hand picking. Rubbish should be removed from under the bushes where the insect hibernates.

THE LIME TREE WINTER MOTH was reported this season in injurious numbers. It seems to remain where the Fall Canker Worm has about disappeared. It was considered and figured in the Report of this Station, 1893, page 161.

THE ARMY WORM made its appearance in limited numbers at Corinth. Mr. W. E. Jordan, who sent us specimens, reported it as feeding on oats.

THE ASH-GRAY PINION was reported again this season as eating into apples. This species is figured in the Report of this

Station, 1888, page 176. The larva of *Pororgia Clintonii* was reported from Aroostook county as feeding on the foliage of apple trees.

THE VELLEDA LAPPET MOTH. This insect was received from Western Maine where it was mistaken for the Gypsy Moth. This species having never been reported before from Maine we give cuts of the moth and larvae.

The body of the larva is covered with warts, which bear tufts of black hairs. On the back and at the sides, gray hairs are mixed with the black. When at rest the caterpillars lie close to the twigs and are hard to see. The flat under-surface is pale orange marked with black dots. See Fig. 6. The moths are gray and white. See Fig. 7.

THE APPLE-TREE TENT CATERPILLAR was very abundant the past season in Western and Southern Maine.

The season has been remarkable for the great number of leaf eating insects reported. Besides those noted or found in the list printed above there were several species of budmoths and leaf rollers, that did much damage. These insects could be controlled by spraying, a practice that is gradually coming into favor among fruit growers in Maine, but which could be employed profitably much more than at present.

THE CURRANT FLY (*Epochra Canadensis*) was more abundant than ever the past season about Orono. It is not generally distributed. There are none in the Station garden, though badly infested gardens occur in Orono.

THE APPLE MAGGOT (*Trypcta pomonella*), we are happy to say, has nearly disappeared in several localities during the past season where it was very bad before. Whether it has really gone or whether the large apple crop has made it appear less numerous on account of abundant food supply is a question. It is probable, however, that the late appearance of snow for the past two years together with freezing and thawing have destroyed the pupae, which are deposited so near the surface. Flies as a class are fragile and subject to injury by great climatic changes.

RAT-TAIL LARVA, the maggot of a species of two winged fly which has a long tail-like appendage to the body, was received for examination.

These maggots live in water or liquid decaying organic matter. So say the books. The long tube like a tail is used as a respiratory organ. One of the specimens received was taken in chip dirt on the floor of a wood-shed. It would seem that they also live in dry situations and put the tube to the surface of the debris to breathe.

From one of the specimens came a large yellowish brown fly. These flies live on the pollen of flowers and are often seen about flowers during the summer.

THE HORN FLY continues to be reported but seems to be on the decrease in Maine.

THE BUFFALO BEETLE is spreading. We have had word of it from several new localities the past season.

THE PIGEON TREMEX is doing considerable damage to maple and other shade trees in some parts of the State.

PTINUS FIR, a small beetle, was reported as badly infesting a bag of timothy seed. The bag had been hanging in a finished room from May until the following March. When examined, thousands of the beetles were found. This is an introduced species from Europe. Probably a few got in before the seed was hung up, and multiplied.

INSECTS EXAMINED IN 1896.

No.	COMMON NAME.	TECHNICAL NAME.	FROM WHOM RECEIVED.	REMARKS.
1	WOOD-LOUSE. SOW BUG	*Oniscus species*	B. Walker McKeen from Auburn,	Eating mushrooms in cellar.
2	CAT TICK	*Ixodes erinaceus*	T. D. Morril, North Yarmouth	On domestic cat.
3	CROTON BUG	*Phyllodromia Germanica*	Mrs. M. O. Edwards, Monmouth.	In store. Probably brought in packing material.
4	GRAPE-VINE LEAF-HOPPER. Thrips	*Erythroneura vitis*, Harris	Ora Knight, Bangor.	
5	OYSTER-SHELL BARK-LOUSE	*Mytilaspis pomorum*	A. S. Field, Bangor Fred S. Wiggin, Maysville	On apple trees.
6	THE HEMISPHERICAL SCALE	*Lecanium hemisphæricum*, Targioni	Eben Webster, Orono.	On ferns in house.
7	ELM-TREE BARK-LOUSE	*Lecanium*	C. H. Morrell, Pittsfield.	
8	THE BUFFALO TREE-HOPPER	*Ceresa bubalus* (Fabr.)	R. A. King, East Monmouth	On foliage of apple trees.
9	YELLOW-NECKED APPLE-TREE CATERPILLAR	*Datana ministra* (Drury)	J. F. Talbot, Andover	Eating foliage of apple trees.
10	RED-HUMPED APPLE-TREE CATERPILLAR	*Œdemasia concinna* (Sm. & Abb.)	F. E. Bixby, Anson	Eating foliage of apple trees.
11	THE FALL CANKER-WORM	*Alsophila pometaria*	Gilman Blood, Foxcroft.	
12	THE CURRANT SPAN-WORM	*Diastictis ribearia*	F. L. Harvey, Orono.	
13	THE GOOSEBERRY FRUIT-WORM	*Dakruma convolutella* (Hübn.)	Mrs. W. H. Davis, West Gardiner,	Attacking the fruit.
14	THE LIME-TREE WINTER MOTH	*Hybernia Tiliaria*, Harris	Gilman Blood, Foxcroft R. A. King, East Monmouth	Attacking apple trees. Attacking apple trees.
15	THE ARMY WORM	*Leucania unipuncta*	W. E. Jordan, Corinth	Attacking oats.
16	THE ASH-GRAY PINION	*Lithophane antennata* (Walker)	C. H. Davis, Harmony	Eating into apples.
17	.....	*Porosagrotis Clintonii*	Bagely Bros., Caribou	Larva feeding on apple.
18	THE PLUM-TREE SPHINX	*Sphinx drupiferarum* (Sm. & Abb.)	O. S. Shaw, Winthrop	On apple tree.
19	FALL WEB-WORM	*Hyphantria textor*, Harris	A. T. Wing, Weld	Pupa on limb of apple tree.

20	THE VELLEDA LAPPET-MOTH.	*Tolype Velleda* (Stoll)	C. H. Thompson, Jay	Mistaken for gypsey moth.
21	APPLE-TREE TENT-CATERPILLAR.	*Clisiocampa Americana*, Harris	D. J. Bixby, South Turner, and several others.	
22	LUNA MOTH	*Tropæa luna*	S. J. Spalding, North Buckfield.	
23	CECROPIA MOTH	*Platysamia Cecropia* (Linn.)	C. Fenderson, Wilton	Cocoon on apple tree.
24	MOURNING CLOAK BUTTERFLY	*Vanessa antiopa*, L	C. H. Morrell, Pittsfield.	
25	RAT-TAIL LARVA	*Mollota*	H. W. Goodwin, West Lewiston	In decaying organic matter.
26	HORN FLY	*Hæmatobia serrata*	J. E. Crocker, St. Albans	On cattle.
27	BUFFALO BEETLE	*Anthrenus Scrophulariæ*, L	Isabel F. Hinckley, Bangor, and others	Destroying carpets.
28	BACON BEETLE	*Dermestes lardarius*	B. H. Dunham, Foxcroft	In pantries from May until October.
29	SUGAR MAPLE BORER.	*Plaginotus speciosus*	Sam. Richards, South Paris	Doing injury to maple trees.
30		*Ptinus fur*	William L. Jackson, Greenfield	Destroying stored Timothy seed.
31	PLUM CURCULIO.	*Conotrachelus nenuphar* (Herbst.).	Chas. Vaughn, Hallowell	Attacking plums.
32	OAK-BARK WEEVEL	*Magdalis olyra* (Herbst.)	C. H. Morrell, Pittsfield	Elm trees.
33	LESSER GRAIN-BEETLE	*Sylvanus surinamensis*, L	N. A. Haskell, New Gloucester	Specimens from Massachusetts.
34	ASH TIMBER-BEETLE	*Hylesenus aculeatus*, Say	W. L. Mowyer, Greene.	
35	MAY-BEETLE	*Lachnosterna fusca* (Frohl.)	Miss M. Minot, Bar Harbor	Feeding on grass roots in lawn.
36	CUCUMBER FLEA-BEETLE	*Crepidodera cucumeris* (Harris).	B. W. McKeen, Augusta	On potato leaves.
37	STEEL-BLUE FLEA-BEETLE	*Haltica chalybea*	C. H. Morrell, Pittsfield	On elms.
38	PEAR-TREE SLUG	*Selandria cerasi*, Peck	C. H. Morrell, Pittsfield	Eating foliage of pear trees.
39	BLACKBERRY SEED-GALL	*Diastrophus cuscutæformis*, O. S	E. F. Roundy, Bangor	Making gall-like excrescence on blackberry leaves.
40	ICHNEUMON	*Pelecinus polyturator*	F. W. Gifford, Dover	About orchards. Probably beneficial.
41	PIGEON TREMEX	*Tremex Columba*, L	S. Richards, South Paris	Boring in maple trees.

A NEW GARDEN SMYNTHURID.

Smynthurus albamaculata n. sp.

By F. L. HARVEY.

Body dull blue-black with steel blue reflections in direct light, obscurely marked with numerous small whitish blotches of variable shape and size, arranged in poorly defined transverse bands, giving a marbled appearance. Head, terminal segments of the body, antennae, legs and elater pale purple. Underside of body pale brownish. Sides of head and the vertex yellowish brown. Eye patches black, bordered on the inner margin by a whitish band which is constricted in the middle giving the appearance of two spots. Antennae more than half as long as the body. Ratio of segments 1:2½:3:5. The basal joint widest, globular and whitish. Base of the second segment light. Terminal segment composed of nine joints. (In young specimens apparently eight jointed by the coalescence of the two terminal). Antennae, legs, elater and body clothed with hairs. Body widest behind, abruptly narrowing into the terminal segments. Anal tubercles prominent. Claws medium size. The larger, .031 m. m. with a single tooth on the inner edge near the end. Short claw, .017 m m. plain, broadest in the middle. Two tenent hairs about the length of the longer claw and extending about two-thirds the length of the claw. Furcula short and stout. Ratio to body 4:7. Ratio of parts of furcula: manubrium 4, dentes 4, mucrones 1. Dentes with about ten bristles on the lower edge. Mucrones curved near the base, narrow lanceolate and plain. Length of insect .8 to 1.4m m.

Habitat:—Found abundantly during May and June in gardens. Doing much damage to early garden plants. Attacks radishes, beans, cucumbers, squashes, etc., eating numerous holes in the epidermis of the leaves and sucking the

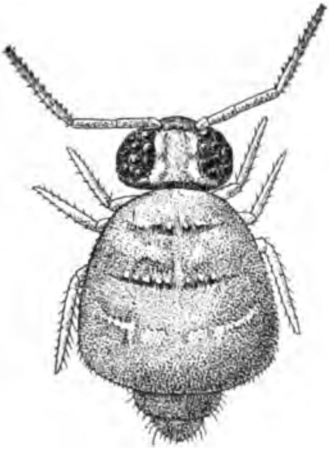


Fig. 1.

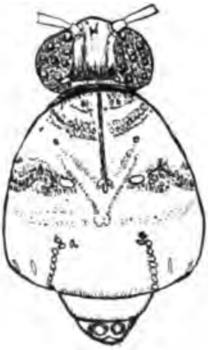


Fig. 3.

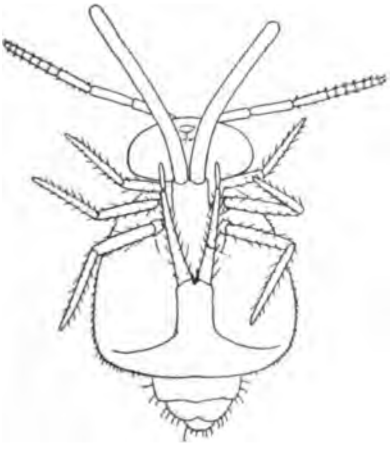


Fig. 2.

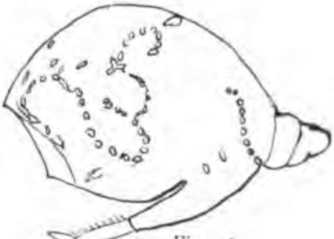


Fig. 4.

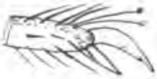


Fig. 5.

Smynthurus albamaculata, Harvey.

juices until the leaves wither. Numerous specimens examined during the last five years. Orono, Me., F. L. Harvey.

Distinguishing characters:—This species has the same habits as Fitch's *S. hortensis* and is equally as injurious. For a long time we took it for that species. It has the dark body and lighter head, legs, antennae and elater of the above. It is, however, readily distinguished by the purple of the head, antennae, terminal segments of the body and elater, the obscure white markings on the body and especially by the nine joints to the terminal segment of the antennae. There being in *S. hortensis six* segment to the terminal joint, according to Fitch and McGillivray—but really seven if Fitch's figure is correct. The only species we know of having been found in America with nine joints to the terminal segment of the antennae is *S. roseus*, Packard, from which our species differs in the color of the body, size and habits.

Remarks:—The young of this species are lighter colored than the adults, appearing brownish to the naked eye and often show only eight joints to the terminal segments of the antennae. The older specimens acquire the blue black color and reflections. The marbled appearance of the body cannot be seen by the naked eye or a hand glass readily and the casual observer would say the body was plain, blackish. The whitish markings can be readily seen by magnifying 75 diameters. They appear as though they were under the skin and show through it. Alcohol and glycerine specimens show the markings plainly.

By careful examination of alcoholic specimens we found there was a median dorsal brownish stripe extending from the head half the length of the body and ending in a clover leaf white spot. There are three obscure transverse bands made up of white spots, giving the surface a mottled appearance. The anterior band from dorsal view shows two white spots each side the median line. The second stripe bears five oblong spots each side of the median line and lower on the sides an S shaped marking composed of a chain of white blotches. Still lower on the side and anterior to the first and sloping forward is another S formed by a chain of spots, the lower loop of the first S making the posterior loop of the second. See Fig. 4.

Starting near the base of the manubrium and running obliquely up the side of the body and ending in the dorsal view is a stripe of oblong whitish spots. The white spot next to the dorsal end placed inward out of line. Fig. 3, a.

We have tried to show the arrangement of these markings in Figs. 3 and 4.

Description of Figures:—Fig. 1, drawn by Mr. J. H. Emerton from live specimens, shows well the form of the body and the obscure transverse bands. The drawing was made from live specimens. Fig. 2, drawn by Mr. Emerton, shows a ventral view of the same. Fig. 3, drawn by the writer, shows in detail the white markings as seen in alcoholic specimens, examined by high powers. No attempt is made to show more than the location of the markings. Fig. 4, is a side view showing location of the spots. Fig. 5, shows structure of the foot.

Remedies:—We do not agree with Fitch that the work of the Smynthurids is entirely secondary, at least this species is capable of sucking the juices in some way without the aid of other insects. The above species was very abundant on cucumbers in my garden this season but we did not notice the Flea Beetle. Some times there would be more than a dozen on a single leaf. In a few days the leaves turned whitish and on examination the epidermis was found full of little pits. Rarely, if ever, was there a hole through the leaf. They attack the new, young plants, eating the seed leaves (cotyledons). The application of dirt, ashes, sulphur or pyrethrum while the dew is on will act as deterrents until the plants are larger when they appear to do but little damage. We searched for specimens June 25th, and found them very scarce.

METEOROLOGICAL OBSERVATIONS.

Reported by L. H. MERRILL.

These observations were made under my direction, by members of the Station force. Readings were taken at 7 A. M., 1 P. M. and 9 P. M. The instruments were those in general use by the Weather Bureau. Lat. 44°, 54′, 2″, N. Long. 68°, 40′, 11″, W. Elevation above the sea, 150 feet.

METEOROLOGICAL SUMMARY

FOR THE SIX MONTHS ENDING DECEMBER 31, 1896.

	July.	August.	September.	October.	November.	December.	Mean.
Highest barometer	30.56	30.43	30.53	30.71	30.94	30.89	30.66
Lowest barometer	23.69	29.85	29.57	29.57	29.69	29.27	29.60
Mean barometer	30.10	30.14	30.17	29.93	30.27	30.20	30.14
Highest temperature	86	92	87	68	68	45	74
Lowest temperature	55	39	28	23	-4	-9	23
Mean temperature	66	65	55	45	35	20	48
Total precipitation	2.58	4.26	8.00	3.75	4.23	1.30	
Number of days with precipitation of .01 inch or more	6	10	9	15	11	6	
Number of clear days	......	10	7	9	5	15	
Number of fair days	....	11	15	9	11	11	
Number of cloudy days	......	10	8	13	14	5	

DIETARY STUDIES AT THE MAINE STATE COLLEGE.

The investigations upon the food and nutrition of man referred to in the Director's Report as in progress in coöperation with the United States Department of Agriculture are reported upon, for the year 1895, in Bulletin 37 of the Office of Experiment Stations on "Dietary Studies at the Maine State College," by W. H. Jordan, the former Director of this Station. The following brief abstract is from that bulletin. A limited number of copies of Bulletin 37, containing the full account of these studies, are at the disposal of the Station. They will be sent to applicants until the supply is exhausted. C. D. W.

Recent discussions in the field of human food economics have dealt largely with the problems involved in purchasing the so-called raw materials. The man of moderate means is taught that whether he is well fed or not does not depend upon what he pays for the food supplied to his family, but is determined by the amount and kind of nutritive ingredients which he consumes. He is told further that the protein from the neck is just as nutritious as the protein from porter-house steak when the skill of the cook renders it as palatable and digestible. It has been repeatedly demonstrated on the basis of chemical analysis and market prices that the edible dry matter of oysters, clams, poultry, and the choice cuts of beef has a market cost much greater than that of the edible dry matter from a fore quarter of beef, or from pork, milk, and cheese. Consequently the housewife and boarding-house steward are assured that there is an opportunity to keep down the cost of supplying the table by purchasing those materials which furnish a unit of nutrition for the least money, provided they can be prepared for the table in such palatable forms that they are relished and eaten without excessive waste.

It is quite evident, however, that these conditions are more difficult in the concrete than in the abstract. The lack of culinary skill, the necessity for a desirable variety of foods, and the marked differences of individual tastes are all obstacles to the easy application of laboratory demonstrations to the management of a dietary.

It was felt that if these views of food economics could be made useful in practice it would be well worth while to show this by accurate experimental data. It was decided, therefore, that nothing could be undertaken more desirable from a practical standpoint than to attempt an application of the considerations above mentioned.

The work attempted was something more than an ordinary dietary study where the supply of raw materials was simply such as would be dictated by the season, condition of the market, etc. It was rather a dietary study where the supply of raw materials was deliberately controlled in such a manner as to make possible a comparison of the relative cost of different sources of supply.

Whatever opinion may be entertained as to the success and value of this experiment, it certainly has the merit of being perhaps the first attempt in this country to apply to the study of human food economics the same deliberate control of the rations that has for a long time been exercised in similar experiments with farm animals.

THE COLLEGE COMMONS AND THE CONDITIONS UNDER WHICH THE EXPERIMENTS WERE MADE.

The college boarding house is connected with a dormitory, and is patronized chiefly by the students living in the dormitory and in neighboring fraternity club houses. Certain members of the college faculty and a few outside students take their dinners at the boarding house regularly, and others occasionally, thus making a larger number of dinners than of other meals. The regular student boarders were, with a single exception, all young men whose ages ranged from seventeen to twenty-three years, and who weighed on an average about 150 pounds.They were all compelled to take a fair amount of physical exercise, due to enforced military drill and to afternoon practice work in the laboratories and with engineering instruments in the field. It may be reasonably claimed that these young men performed a considerable amount of work. There were also several women, boarders and employees, who had meals regularly at the commons.

The college commons is conducted on the plan of furnishing the students with their board at cost, with the expectation that the weekly charge shall not exceed $3 nor fall below $2.50. As a matter of fact, the cost during these dietary studies was about $2.75 per week.

The general plan of the studies may be briefly outlined as follows: At the beginning of each dietary study a careful inventory by weight was taken of all the food and food materials in the house. During the experimental period all food purchased was weighed and recorded in the same way, and all table and kitchen waste carefully collected, weighed, and desiccated for subsequent analysis. At the close of the period a second inventory of all materials on hand was taken. In this way the necessary data for ascertaining the net amounts of food consumed were secured. In nearly all cases, except with meats, samples of food materials on hand or purchased during the period were secured for analysis.

THE QUESTIONS STUDIED.

In these dietary studies, as already stated, the attempt was made to deliberately control to some extent the source and supply of animal foods. The object of this control was to bring into comparison high-cost and low-cost foods as a source of protein, with especial attention to the influence of the free use of milk as a low-cost animal food upon the character and cost of the dietary.

Milk was selected for special consideration for the following reasons:

(1) Milk has a widespread use as an article of diet, and in all civilized countries is an important item of food supply.

(2) Milk is a very valuable food. It contains a mixture of the three classes of nutrients in forms that are readily digested and assimilated.

(3) Milk is a low-cost animal food in proportion to its value as based upon chemical analysis. When milk is purchased at $2 per hundred pounds the cost of a pound of edible solids is 15.7 cents, while the cost of a pound of edible solids in beef at $10.50 per hundred pounds is 34.3 cents. This is a comparison of the retail cost of milk with the cost of hind-quarter beef when purchased by the carcass. Beef bought as steak at retail prices would have a much higher comparative cost.

(4) Notwithstanding the high quality and very general distribution of milk as a food, it seems by many to be regarded as a luxury in the purchase of which economy must be exercised. This attitude toward this particular food may in part be explained by the somewhat prevalent notion that a free supply of milk in the dietary is not economical, because it is supposed that as much of other foods is eaten as would be the case if the milk were not taken. This belief runs contrary to certain generally accepted facts which relate to the physiological use of foods, and it only remains for experimental data to prove or disprove its correctness. Again, milk is not given full credit by people at large for its true nutritive value. Surprise is generally occasioned by the statement that a quart of milk has approximately the food value of a pound of steak. It is important to demonstrate for reasons of economy whether, as is the custom with many, it is wise to purchase the least possible quantity of milk and exercise little care in buying meats.

To investigate these questions, five dietary studies were made, as follows:

The first dietary study was made under ordinary conditions, no attempt being made to select the food with any end in view, except to secure the necessary variety. In the second dietary the protein was secured from high-priced sources, and the milk supply was kept at a minimum. In the third dietary study the protein was supplied from less costly sources, and the milk consumption was increased to a maximum. The fourth dietary study was made under normal conditions, except that the milk supply was limited. The fifth dietary study was also made under ordinary conditions, except that milk was very abundantly supplied.

COMPARATIVE QUANTITY AND COST OF ANIMAL AND VEGETABLE FOODS.

It is interesting and suggestive to note the relations in quantity and cost of the animal and vegetable foods in the five dietaries. These relations are very clearly shown in the following abstract of figures from the second table in each dietary:

RELATIVE AMOUNTS OF NUTRIENTS IN ANIMAL AND VEGETABLE FOODS.

	Food materials.	Nutrients.			Cost.
		Protein.	Fats.	Carbohydrates.	
First dietary (No. 148):	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Animal food.	51.8	59.8	93.5	5.8	63.7
Vegetable food	48.2	40.2	6.5	94.2	36.3
Second dietary (No. 149):					
Animal food	57.4	71.7	96.5	8.6	72.8
Vegetable food	42.6	28.3	3.5	91.4	27.2
Third dietary (No. 150):					
Animal food	58.6	63.4	95.3	9.8	66.4
Vegetable food	41.4	36.6	4.7	90.2	33.9
Fourth dietary (No. 151):					
Animal food	48.7	56.7	94.5	6.7	71.0
Vegetable food	51.3	43.3	5.5	93.3	29.0
Fifth dietary (No. 152):					
Animal food	60.3	64.2	95.7	12.3	73.1
Vegetable food	39.7	35.8	4.3	87.7	26.9
Average:					
Animal food	54.5	63.0	95.0	9.0	69.0
Vegetable food	45.5	37.0	5.0	91.0	31.0

The gross weight of the animal foods purchased varied from 48.7 to 60.3 per cent. of the total food, and their cost varied from 63.7 to 73.1 per cent. of the total cost. The average gross weight of the animal foods for the entire 209 days was 54.5 per cent. of the total food weight, and their proportion of cost was 69.2 per cent. of the total cost. These figures illustrate the relative economic importance of the animal food of the dietary, and, considered in connection with the great variation in the cost of the nutrients in the different kinds of meat, show very clearly the direction in which a family of moderate means has the largest and most promising opportunity for the exercise of economy.

When we see that practically two-thirds of the protein and nearly all of the fat were supplied from the animal foods and over nine-tenths of the carbohydrates from the vegetable foods, it is easy to understand how the character of the diet is readily modified by varying the proportions of the two classes of nutrients. The family that is able to afford a generous supply of meats is very differently nourished from the families of limited means, where the flour barrel is the chief source of food.

THE REFUSE AND WASTE.

That portion of the food materials which was not eaten included not only that which was edible and was really wasted, but also the refuse, or that which, because not edible, was necessarily rejected. The percentages of the waste in the five dietary studies follow:

SUMMARY OF WASTE IN THE FIVE DIETARY STUDIES.

	Total.	Protein.	Fats.	Carbohydrates.	Fuel value.
First dietary (No. 148):	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Animal	7.5	16.1	30.8	....	11.7
Vegetable	9.7	5.3	.9	12.7	8.1
Total	17.2	21.4	31.7	12.7	19.8
Second dietary (No. 149):					
Animal	13.0	29.3	33.9	.. ..	17.8
Vegetable	10.7	5.4	.6	16.3	8.4
Total	23.7	34.7	34.5	16.3	26.2
Third dietary (No. 150):					
Animal	13.5	20.4	50.0	....	21.2
Vegetable	14.1	7.9	.8	19.9	11.3
Total	27.6	28.3	50.8	19.9	32.5
Fourth dietary (No. 151):					
Animal	2.0	5.6	1.0	.1	....
Vegetable	12.9	9.5	11.5	15.5	....
Total	14.9	15.1	12.5	15.6	14.4
Fifth dietary (No. 152):					
Animal	1.8	6.8	1.3	.3	....
Vegetable	13.3	10.2	12.4	16.8	....
Total	15.1	17.0	11.1	17.1	15.1

A fair discussion of the preceding figures requires the statement that the college commons was not under the same management in the spring term, including dietaries 1, 2, and 3, as in the fall term during dietaries 4 and 5.

In the spring term the waste was 17.2 per cent. of organic matter during the first dietary, and increased from this to 24 per cent. in the second dietary and 28 per cent. in the third. The excessive waste in the third dietary was probably due in part to the large proportion of fat in the meats, which would be rejected during warm weather.

Dietaries 4 and 5 stand in strong contrast to dietaries 1, 2, and 3, as in the former the waste did not exceed 14.5 per cent. This is a striking illustration of the possible difference which may exist in the economy of management of the food supply of a family or boarding house.

The large waste of nutrients in the spring term is emphasized by the fact that the loss of fats was in greater proportion than that of other nutrients, thus involving a larger relative waste of food energy than is indicated by the percentages of organic matter. When the waste of organic matter was 17.2, 24, and 27 per cent, the corresponding waste of fuel value was 20, 26, and 32 per cent.

While the waste in the fall term is not as low as it might be under more favorable circumstances, it was not greater than frequently exists under boarding-house conditions, where there is not a concerted action on the part of the boarders toward economizing in all reasonable ways.

THE FOOD ACTUALLY EATEN.

In considering the results of these dietary studies, so far as it relates to food consumption the following facts pertaining to the conditions should be taken into account:

In the spring term the period of observation began during the cold weather of February and ended during the warm weather of June, and included a period during which there is usually a marked decrease of appetite.

In the fall term the conditions were reversed, and there was a gradual change to cold weather, which, other things being equal increases the appetite.

The supply of animal foods, and to some extent of vegetable foods, was purposely changed in passing from one period to another.

The nutrients consumed in these dietary studies are briefly summarized in the following table:

SUMMARY OF AMOUNTS AND FUEL VALUE OF NUTRIENTS CONSUMED.

	Protein.	Fats.	Carbohydrates.	Fuel value.
SPRING TERM.	Grams.	Grams.	Grams.	Calories
First dietary (No. 148): Usual food supply...	132	147	751	4,990
Second dietary (No. 149): Costly meats; milk limited	112	164	517	4,105
Third dietary (No. 150): Milk in abundance; other protein less costly..........	112	106	530	3,620
FALL TERM.				
Fourth dietary (No. 151): Milk supply limited	131	181	579	4,595
Fifth dietary (No. 152): Milk supply unlimited	120	184	436	3,990
Voit's standard, man at moderate work	118	56	500	3,055
American standard (Atwater), man at moderate work	125	....	....	3,500

It will be noticed that the consumption of fats and carbohydrates was especially large, while the amount of protein was more nearly in accord with the so-called dietary standards.

The amount of nutrients consumed in the first dietary (from February 25 to April 24) is especially excessive, particularly in the case of the carbohydrates. While this may be explained in part by the uniformly keener appetites of the students at the beginning of a term, it was probably chiefly due to the abundant supply of maple sirup which was furnished during this period. The use of so much sirup involved a correspondingly large consumption of flour. Seventy-four grams of maple sirup and 358 grams of flour were consumed daily per man during the first dietary, whereas during the succeeding dietaries scarcely any sirup was eaten and only 281 grams of flour per day. There can be but little doubt that the free use of sirup on the table leads to an excessive proportion of carbohydrates in the dietary.

The marked decrease in the food consumption as the term progressed is probably accounted for by the gradual elevation of temperature and the changes in the physical condition of the students. The food consumption changed from a fuel value of about 5,000 calories in February, March, and April to less than 3,700 calories in May and June.

THE INFLUENCE OF THE SUPPLY OF ANIMAL FOODS UPON THE SIZE AND COST OF THE DIETARY, WITH ESPECIAL REFERENCE TO MILK.

As has been stated, the attempt was made in four dietary studies to deliberately control to some extent the supply of animal foods and the source of protein. The attempt was also made to determine the relative value of milk in the dietaries.

The following table briefly summarizes the amounts and kinds of food materials purchased in the four dietaries:

FOODS PURCHASED IN FOUR DIETARIES.

	Foods Purchased Daily Per Man.			
	Dietary 149: Milk limited, other protein high cost.	Dietary 150: Milk unlimited, other protein low cost.	Dietary 151: Milk limited.	Dietary 152: Milk unlimited.
Animal food:	Grams.	Grams.	Grams.	Grams.
Beef, veal and mutton	337	130	241	211
Pork, lard, etc.	76	172	114	132
Poultry	71		9	14
Fish, etc	89	69	61	54
Eggs	112	53	49	28
Butter	83	74	67	40
Milk	810	1,197	873	1,223
Mince meat				2
Total	1,611	1,695	1,414	1,704
Vegetable food:				
Cereals, sugars, etc.	476	585	576	460
Vegetables	638	477	671	464
Fruits	80	121	243	202
Total	1,195	1,193	1,490	1,126
Total food	2,806	2,888	2,904	2,836

In the following table the results of the studies are shown in another form:

GROSS WEIGHTS OF FOOD PURCHASED PER MAN PER DAY.

	Milk.	Animal foods other than milk.	Vegetable foods.	Total foods.
	Grams.	Grams.	Grams.	Grams.
Dietary No. 149: Milk supply limited; high-cost protein	810	801	1,204	2,906
Dietary No. 150: Milk supply unlimited; lower-cost protein	1,197	498	1,203	2,888
Dietary No. 151: Milk supply limited	873	541	1,498	2,904
Dietary No. 152: Milk supply unlimited	1,223	481	1,126	2,836

The tables show very conclusively that the intention to materially modify the kind of animal foods in passing from dietary No. 149 to dietary No. 150 was carried out. The use of beef, veal, mutton, poultry, and eggs was greatly diminished and the consumption of pork and milk increased. The butter eaten was less in the latter period also. In dietaries Nos. 151 and 152 the character of the animal foods other than the milk did not differ greatly. The quantities of high-cost meats were less, but their place was not taken by low-cost meats.

The above figures leave no room for doubt that the free use of milk diminishes the consumption of other foods. In passing from dietary No. 149 to No. 150 the milk consumption per man increased from 810 grams daily to 1,197, and the use of other animal foods decreased from 801 grams to 498 grams, while the vegetable foods were eaten in about the same quantities in the two studies.

Essentially the same result follows in dietaries Nos. 151 and 152, where the milk eaten increased from 873 grams daily to 1,223, the consumption of other animal foods decreasing from 541 grams to 481, and of vegetable foods from 1,490 to 1,126 grams. In the first instance the milk replaced other animal foods, and in the second there was mainly a decrease in the use of vegetable foods. But while the increased consumption of milk diminished the consumption of other materials, what was the effect upon the actual quantity of nutrients taken and upon the cost of the dietary?

The answer to the question is very definite, and may be found in the following comparison of the results of the investigations:

COMPARISON OF NUTRIENTS EATEN.

	Nutrients per Day per Man.				
	Protein.	Fats.	Carbohydrates.	Total.	Cost.
Second dietary (No. 149): Milk limited:	Grams.	Grams.	Grams.	Grams.	Cents.
Animal foods..	72	158	53	283	....
Vegetable foods	40	6	464	510	....
Total foods	112	164	517	793	34
Third dietary (No. 150): Milk unlimited:					
Animal foods....	67	98	65	230	....
Vegetable foods	45	8	465	518	....
Total foods......	112	106	530	748	26

COMPARISON OF NUTRIENTS EATEN—CONCLUDED.

	NUTRIENTS PER DAY PER MAN.				
	Protein.	Fats.	Carbohydrates.	Total.	Cost.
Fourth dietary (No. 151): Milk limited:	Grams.	Grams.	Grams.	Grams.	Cents.
Animal foods	79	......	45	......	......
Vegetable foods	52	......	534	......	......
Total foods	131	181	579	891	27
Fifth dietary (No. 152): Milk unlimited:					
Animal foods	83	......	64	......	......
Vegetable foods	37	......	372	......	......
Total foods	120	184	436	740	25

The results are stated in another form in the following table:

SUMMARY OF NUTRIENTS EATEN DAILY PER MAN.

	Protein.	Fat.	Carbohydrates.	Total.	Daily cost per man.
SPRING TERM.					
Second dietary (No. 149):	Grams.	Grams.	Grams.	Grams.	Cents.
Milk supply limited	112	164	517	793	34
Third dietary (No. 150):					
Milk supply unlimited	112	106	530	748	26
Difference, (increase +, decrease —)	....	—58	+13	—45	—8
FALL TERM.					
Fourth dietary (No. 151):					
Milk supply limited	131	181	579	891	27
Fifth dietary (No. 152):					
Milk supply unlimited	120	184	436	740	25
Difference (increase +, decrease —)	—11	+3	—143	—151	—2

It appears that instead of causing an increased consumption of nutrients, the freer use of milk was attended by a decrease of the nutrients eaten in the spring term amounting to 45 grams daily and in the fall term to 151 grams daily. In the spring term it might reasonably be urged that the coming of warm weather would have the effect noted, all other conditions remaining the same, but this cause certainly could not have been operative in the fall term, when milk was freely supplied, for cold weather came on, and this ordinarily causes a keener appetite. It is interesting to note that in the spring term the additional milk replaced other animal foods, while in the fall term it replaced vegetable foods. It is reasonable to regard this as to some extent a case of involuntary selection of foods, as with the advent of warm weather the tendency would be to reject animal foods, while the effect of cold weather would be the reverse.

The financial outcome is favorable to the free use of milk. Notwithstanding the largely increased waste, the cost per man per day in the third dietary is 8 cents less than in the second.

The total decrease in the cost of food during dietary No. 150 as compared with dietary No. 149 was about $4.50 per day. The saving should not be credited wholly to the increased supply of milk, because the other animal foods were in part of a less expensive kind.

The saving in dietary No. 152 was less, amounting to only 2 cents per day per man, or a total of $1.57 daily. This smaller saving is equal, however, to $416 for a school year of thirty-six weeks with the number of persons included in third dietary study. It should be noted that this saving was made in spite of the increased proportion of animal foods, an increase which, other conditions remaining unchanged, raises the cost of living.

If, as we have reason to believe, it be true that the average American dietary contains too large a proportion of non-nitrogenous compounds, then the free use of milk, besides cheapening the cost of living, accomplished another desirable result, viz., it raised the proportion of protein in the dietary, thereby making it more rational. The nutritive ratios of the dietaries with a limited supply of milk were 1:7.9 and 1:7.5, and of the dietaries where milk was freely used 1:6.7 and 1:6.8.

SUMMARY.

The main results of these dietary studies are briefly summarized with especial reference to their important practical relations to the economical purchase of human foods.

(1) The cost of the animal foods bought for the commons of the Maine State College during 209 days was 69 per cent. of the total food cost, varying in the different periods from 63.7 to 73.1 per cent. This shows very clearly the direction in which economy can most effectively be exercised in purchasing a food supply.

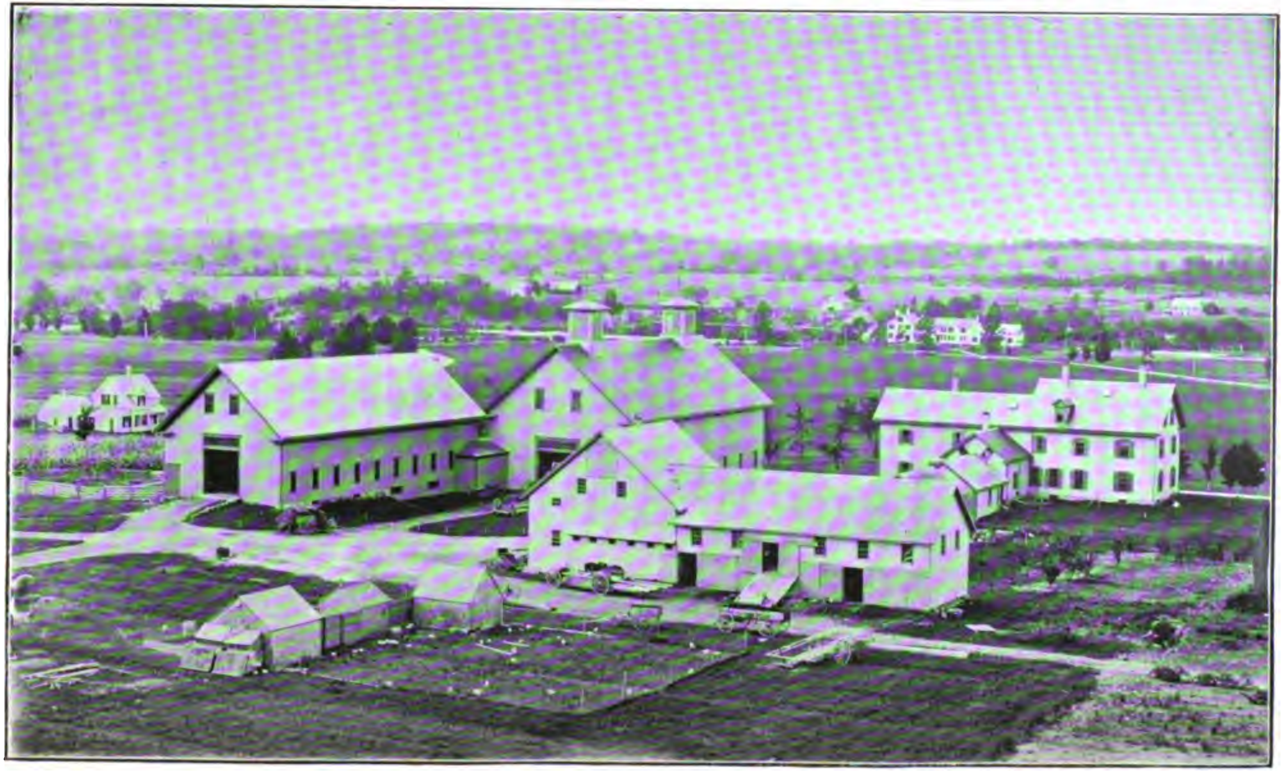
(2) The freer use of milk did not, as is supposed by some to be the case, increase the gross weight of food eaten. The extra amount of milk consumed replaced other animal foods to a nearly corresponding extent in the first trial and caused a proportionate diminution in the consumption of vegetable foods in the second study.

(3) The actual quantity of water-free nutrients eaten diminished rather than increased when more milk was supplied. This is in marked contrast to the apparent effect of the free use of maple sirup, which was accompanied by a notably large consumption of nutrients.

(4) In both trials the increased consumption of milk had the effect of materially narrowing the nutritive ratio of the dietary, a result which, in view of the recognized tendency of Americans to consume an undue proportion of fats and carbohydrates, appears to be generally desirable.

(5) The dietaries in which milk was more abundantly supplied were somewhat less costly than the others and at the same time were fully as acceptable.

(6) These results indicate that milk should not be regarded as a luxury, but as an economical article of diet, which families of moderate income may freely purchase as a probable means of improving the character of the dietary and of cheapening the cost of their supply of animal foods.



STATION FARM BUILDINGS.

BULLETIN No. 23.

PRESERVATION OF CREAM FOR MARKET.

F. L. RUSSELL.

It is an important feature of our dairy business that there is a growing demand for fresh sweet cream, not only for domestic use, but for exporting to the large cities. During the past year this cream trade from Maine has considerably exceeded $150,000 and each year finds the demand increasing. It has come to be an important question how best to foster this branch of our dairy business, and during that season when butter is most abundant and cheapest—for there is the greatest demand for cream during the summer months—to find a profitable market for this commodity and so reduce the butter supply and at the same time increase the profit from the dairy. One important reason for fostering the cream trade is that cream sold to be consumed as cream is in no large degree a rival of either milk or butter, but enlarges the demand for dairy products at a time when such products are most abundant and most cheaply produced.

The only obstacle in the way of this trade that has retarded its development is the perishable nature of cream. While it is but little more perishable than milk, it is in a sense a manufactured product and subject to delays in the process of manufacture before it can find its way to market. This difficulty is in a measure overcome by the perfecting of cream separators which quickly condense the cream from the milk without any long delay or opportunity for change, or by what is often found to be a more practical way, the cream obtained from the milk by the deep cold setting process is condensed by the separator while it is yet sweet and comparatively fresh.

One reason why there has been more risk in handling cream than milk is the greater value of the cream, involving greater loss when it fails to reach the market in good condition.

As is very generally known at the present time, the souring of cream is due to the growth of minute organisms or plants called bacteria. These bacteria are not present in the milk while it is yet in the udder of the cow, but they are so universally distributed, especially in warm weather, about the barns and in the dust of the air, that the milk has scarcely reached the pail on its way from the udder of the cow before it is contaminated with them. Under favorable conditions for their growth they will cause the milk or cream separated from it to sour and no ordinary straining or even passing the milk through a cream separator will remove them. After the bacteria that cause souring of milk and cream are once introduced, they will multiply rapidly and soon do their work unless they are destroyed or held in check, that is, their growth and multiplying prevented.

METHODS OF DESTROYING THE GERMS.

There seem to be but three methods of preventing this growth and consequent souring of the cream: First, by means of cold; second, addition to the milk or cream of some germicide like boric or salicylic acid; or third, by subjecting the cream to a sufficiently high temperature to destroy the germs. Each of these methods has its advantages and disadvantages when put to practical use, and it is the purpose of this bulletin to show which of them has the most to recommend it.

USE OF COLD.

In this climate during steady cold weather there can be but little objection to the use of cold as a preservative in shipping cream to local markets. Cream that is kept at a temperature below 45 F. will remain sweet for a long time, but in warm weather and when it has to be shipped to a distant point in warm cars, the necessary cold is secured by the use of ice, which is an unsatisfactory method on account of expense, although the quality of the cream brought to market by this method is of the highest.

USE OF GERMICIDES.

The method of adding something to the cream that will destroy the bacteria or prevent their growth, no matter how warm the weather or how distant the market, appeals to the dealer on account of its cheapness, simplicity and effectiveness. Cream in which a sufficient quantity of boric acid or salicylic acid has been introduced, for these are the substances generally used as preservatives of cream, will remain perfectly sweet for an indefinite time even in the hottest summer temperature. These chemicals produce no decided change in the taste or appearance of the cream, and it is no wonder that this method has sometimes been adopted by those who have seen in it a solution of the only difficulty in the way of extending a lucrative cream trade. What, then, are the objections to this method? The first and the very decided objection that will occur to the consumer is, that when paying for sweet and wholesome cream he does not want it diluted with anything else. In view of the comparatively small quantity of the preservative that has to be used, this objection might be overcome by an appeal to the reason of the consumer, if he did not have reason as well as prejudice on his side. If it could be shown that the preservative was as harmless as the cream itself there would, perhaps, be no reasonable objection to it, but the best that can be claimed for these chemical preservatives is, that while they are sure death to bacteria they also endanger the health and derange the digestive apparatus of human beings. Among those qualified to judge of the effect of these substances when taken into the stomach of human beings, there is practically but one opinion, and that is, that the constant consumption of them is harmful even if taken in small quantities. In certain cases where persons are suffering from disease of the digestive organisms, the use of cream preserved by this method is positively dangerous.

The statement is made by Foraster and quoted in the National Dispensatory that boric acid greatly increases the fecal solids and the excretion of albuminous compounds,even when given in a daily dose of seven or eight grains, and that these effects continue for some time after the suppression of the medicine.

The United States dispensatory says that the practice of using salicylic acid for a preservative of articles of food is to be condemned. A commission appointed by the French government reported that the prolonged use of even a very small amount of salicylic acid is dangerous, especially to very aged persons.

It is not difficult to see that it will be fatal to the permanent interests of the cream trade if dependence is placed upon chemical preservatives to keep the cream sweet. Such a practice is quite easily detected by chemical tests and a well founded suspicion that it is commonly resorted to can only work injury to the trade, even in cream preserved by unobjectionable methods.

USE OF HEAT.—PASTEURIZATION.

The third method for keeping cream sweet until it reaches the consumer, namely, by the use of heat, is based upon the fact that bacteria that cause souring of cream are destroyed at a temperature which leaves the cream uninjured. By practical tests it has been found that a temperature of 155 deg. F. continued for ten minutes will destroy nearly all of the souring organisms without seriously injuring the appearance and without perceptibly affecting the taste or wholesomeness of the cream. This method is termed "pasteurization." While pasteurization may not destroy all bacteria that are sometimes found in cream, so that there is no possibility that souring will take place afterwards, it does destroy most of them, and if cream so treated is at once placed in sterilized cans with proper precautions to guard against introducing any more germs, it has been found in practice that it can be shipped to distant markets under all conditions of weather and reach the consumer in a perfectly sweet condition. Pasteurized cream has been successfully shipped from Wisconsin to Maine and California and intermediate points with perfect success.

Perhaps the chief objection that can be urged against this method is the fact that after being heated to 155 deg. F. the cream never seems quite as thick as before, but this is an objection that has little weight when the true cause is known. The taste and appearance, aside from thinness, is like that of fresh cream.

To pasteurize cream it is only necessary to quickly warm it to 155° F., allow it to remain at this temperature for ten minutes and then cool it as quickly as possible. To do this rapidly on a commercial scale requires specially devised apparatus, several forms of which are already on the market. It will be seen that this method involves slightly more trouble and expense than that of preserving with chemicals, but it seems to us that it is the only practical method that is not open to very serious objections and it renders possible a large and permanent extension of what is already a considerable business in this State, and it will without doubt pay the dealers in this commodity to look well into the advantages of this method over any other at their command.

It may not be out of place in this connection to state that the Maine Experiment Station has ordered a pasteurizing apparatus of an improved pattern, which can be seen here a little later by those interested in the cream trade. We intend to carefully investigate the effectiveness of the apparatus and, if it meets with our expectations, we shall be inclined to urge upon the creamery men of the State the advisability of the pasteurizing method of preserving cream in place of the more expensive or otherwise objectionable methods that have formerly been used.

MAINE STATE COLLEGE, Orono, Me., Feb. 24, 1896.

BULLETIN No. 24.

CABBAGES.

H. P. GOULD.

The purpose of this bulletin is to give a concise account of our experience with cabbages during the past season, with a brief discussion of the evidence presented.

The seed was sown April 1st, and the seedlings pricked out into seed-flats April 27th, and set in the field May 25th. The season being exceptionally dry, all of the plants made a weak growth and correspondingly small heads.

1. *Influence of size of seed:*—The idea has been advanced that it is the tendency of plants from large seeds to run to leaves at

the expense of the head, while the tendency of plants from small seeds is to run to head. In order to study the influence of the size of seed on the relative size of the head, fifty of the largest seeds, also fifty of the smallest were selected from each of three varieties. Of two of the varieties, the weight of the smaller seeds was less than half that of the larger; the weight of the smaller seeds of the other variety was a little more than half that of the larger. Each lot of fifty seeds was sowed, and when the plantlets were ready for the first handling, twenty of the best plants from each lot were selected and handled as above stated.

Table I gives the ratio of the average weight of the heads from the small seed to that of the heads from the large seed.

TABLE I.

	Ballhead.	Reynolds' Early.	Harvest Home.
Large seed	1.69	1.37	.94
Small seed	1.00	1.00	1.00

The facts are too obvious to need extended explanation. The large seed of two of the varieties, Ballhead and Reynolds' Early, produced heads which averaged 69 per cent. and 37 per cent. larger respectively, than did those from the small seed. The other variety—Harvest Home—gave contradictory results, the heads from the small seed averaging 6 per cent. heavier than those from the large seed.

2. *Results of tying up the outer leaves*:—It has been thought by some one that by drawing the leaves of the cabbage together and binding them with a string over the head, maturity would be hastened. Accordingly, with this idea in mind, as soon as the heads had fairly commenced to form, three lots of plants were treated in the way described above, i. e., the points of the leaves were drawn together over the head and a string tied around them sufficiently tight to keep them in the desired position. The results obtained relative to the point in question cannot well be expressed by figures, but suffice it to say that the operation seemed to have no influence whatever upon the date of maturity. This treatment, however, was not without its effect, as the figures in table II will show.

TABLE II.

	Harvest Home.	Surehead.	Reynolds' Early.
Outer leaves tied up	.44	.46	.67
Check	1.00	1.00	1.00

Representing the weight of an average head from the check plants by 1 or 100 per cent., an average head from the Harvest Home which received the special treatment, would be represented by 44 per cent. In the same manner, we observe that the heads from the treated plants of Surehead were only 46 per cent. as heavy as the untreated, and Reynolds' Early, 67 per cent. In a word, the size of the heads from the treated plants averaged from 33 per cent. to 56 per cent. by weight smaller than did those from the untreated plants.

Another result of this operation which was even more noticeable than the decreased size of the heads, was the effect upon quality. Although all possible care was taken in tying up the leaves, they did not overlap sufficiently to keep out all moisture, so that during rains a considerable amount of water entered each head. This moisture being so inclosed within the leaves, did not readily evaporate. As a result of this continued dampness, the inner portions of the plants very soon began to decay; it was not long before this effect became noticeable upon the outer leaves, resulting in a large proportion of the leaves falling off long before the season of growth would otherwise have ceased. As a result of this decay, not a single head was produced fit for home use, to say nothing about its marketable qualities.

3. *Effect of Mulching:*—The advisability of using straw or some similar material as a mulch for the purpose of conserving the soil moisture has often been discussed. In order to ascertain the advantages, if any, of such treatment in the culture of the cabbage, three lots of plants, as soon as they were fairly started after being set in the field, were thoroughly mulched with swale hay so that when packed down the mulch was two or three inches thick, the space between the rows of plants being

completely covered. Three lots of plants, corresponding to those mulched, received frequent cultivation. So far as the maturity of the heads was concerned or the per cent. of plants forming heads, the mulching seemed to have no appreciable effect. There was a slight increase in the size of the heads favoring the use of the mulch, as shown in the following table:

TABLE III.

	Lupton.	Surehead.	Harvest Home.
Mulched	1.00	1.07	1.13
Cultivated	1.00	1.00	1.00

The differences are not sufficient to be very conclusive. It will be noticed that there was no difference in the case of the Lupton between the average weights of the heads from the two lots, while the average weights of the other two varieties were only 7 per cent. and 13 per cent. in favor of the plants which were mulched. These differences are so small that we would not feel justified in making too strong claims for the advantages of mulching, as the variations might result from some other causes, yet we may infer from the indications that a mulch can be applied to advantage, especially in a dry season.

4. *Shallow vs. Deep Cultivation*:—It has been our practice in the cultivation of the cabbage, as in that of nearly all vegetables, to use the horse-cultivator with much freedom, running the cultivator as close to the plants as possible without disturbing them. This, oftentimes, becomes in effect a method of root pruning, giving rise to the question,—Does deep cultivation affect the heading of the plants? For the purpose of ascertaining, if possible, the effect of such treatment, four lots of plants were cultivated as described above, while four similar lots were given only such cultivation as could readily be furnished with a common hoe. The various lots of plants were all cultivated with the same frequency, the only difference being the depth to which the soil was stirred. The following table gives the comparative results:

TABLE IV.

VARIETY AND TREATMENT.	Per cent of immature heads.	Ratio of average weight per head.
Surehead:		
Shallow cultivation	10.5	1.16
Deep cultivation	.6	1.00
One-hundred Weight:		
Shallow cultivation	11.1	1.12
Deep cultivation	.0	1.00
Lupton:		
Shallow cultivation	5.3	.98
Deep cultivation	12.5	1.00
Harvest Home:		
Shallow cultivation	52.6	.72
Deep cultivation	5.0	1.00

The effects as expressed by the above figures are somewhat contradictory. In the case of all but one of the varieties, Lupton being the exception, a larger percentage of the heads from plants which received shallow cultivation were immature at the time when most of the heads were ready for cutting, than from those receiving deep cultivation, the difference varying from about 10 per cent. to over 47 per cent. It seems probable that the deep cultivation which gave to the plants a heavier mulch of finely pulverized soil than that given to the plants receiving the shallow cultivation, so aided in the conservation of the moisture that the plants were able to make a more vigorous growth, and to form more perfect and uniform heads. No specific conclusion can be drawn from a comparison of the average weights, as two of the varieties gave results favoring deep cultivation, while two were against the practice, though the greater difference was in favor of deep cultivation.

RECAPITULATION.

1. The size of the seed seems to have some influence upon the size of the head, the larger seed, as a rule, producing the larger head.

2. The tying up of the outer leaves seems to have no influence upon the maturity of the heads, while it produces a marked decrease in the size and almost invariably causes the head to decay.

3. Mulching with straw or some similar material in a dry season tends to increase the size of the head.

4. Deep cultivation seems to have little if any effect upon the size of the head, but plants so treated appeared to mature more uniformily than plants receiving shallow cultivation.

MAINE STATE COLLEGE,
ORONO, ME., March 1, 1896.

BULLETIN No. 25.

INSPECTON OF FERTILIZERS, 1896.

The bulletin gave the manufacturer's guarantees and the analyses of manufacturer's samples, but as these figures are of only passing value they are omitted here.

BULLETIN No. 26.

INSPECTION OF GLASSWARE USED BY CREAMERIES AND BUTTER FACTORIES TO DETERMINE THE VALUE OF CREAM AND MILK.

J. M. BARTLETT.

Ever since the introduction of the Babcock test for estimating the value of cream or milk at creameries and butter factories, more or less dissatisfaction and in some cases distrust, have prevailed among a few patrons to whom payment has been made on this basis. These complaints have come in various forms. Some creameries have been accused of using incorrectly graduated glassware, pipettes that were too small, thereby making the test too low; others of employing incompetent men to manipulate the test.

In order to remedy such evils if they existed and restore confidence to the minds of the patrons, a law was enacted by the Maine Legislature of 1895, entitled "An act for the Protection of Dairymen," which appears as Chap. 169 of the laws of 1895. Without giving the full text of this law, there is stated below a summary of its principal provisions and requirements.

Section 1. This section requires that every individual or corporation buying milk or cream or apportioning its value on the basis of the fat content shall have all the bottles and pipettes tested for accuracy, which are used in determining the per cent. of fat, and each of these bottles and pipettes shall bear a mark showing that it has been so tested.

Sec. 2. In this section it is made the duty of the Director of the Maine Experiment Station or some person he may designate to execute the provisions of Section 1. The actual expense of this work shall be paid by the persons or corporations for whom it is done.

Sec. 3. This section requires that any person operating the Babcock or other tests for determining the fat in milk or cream which is to be purchased or its value apportioned, must possess a certificate of competency for such work. This certificate is to be issued by the Superintendent of the State College Dairy School in accordance with such rules and regulations as he may devise.

Sec. 4. No one is allowed to use at any creamery, butter factory, cheese factory or condensed milk factory where milk or cream is bought or its value apportioned, or to have in his possession with intent to use, any sulphuric acid of less than one and eighty-two hundredths specific gravity. This section also provides penalties for the violation of the provisions of this act.

Sec. 5. This section fixed the date on which this law shall take effect which is six months from the day of approval, or September 27, 1895.

Early in the spring of 1895 a circular letter was sent to each creamery with which was enclosed a copy of the law giving notice that the Station would be ready to test all glassware after June 1. The examination of candidates and issuing of certificates of competency for making the test was conducted by Professor G. M. Gowell, superintendent of the dairy school, and the work of testing the glassware was delegated to the writer.

METHOD OF MAKING THE TEST.

For this purpose we had made an accurately graduated burette of the same diameter and marked the same as the necks of the cream bottles. The bottle to be tested is filled to the zero mark with mercury as is also the burette. Then the mercury is allowed to run slowly from the burette into the bottle until the upper line of the mercury stands at the 5 per cent. mark on the burette. The mark at which the upper line of the mercury stands in the neck of the bottle is also noted and if it coincides with the 5 per cent. mark, the graduation is correct. Another portion is now run in until the 10 per cent. mark on the burette is reached and so on until the 25 per cent. mark is reached. Slight errors like one or two-tenths of 1 per cent. have been passed unnoticed, but when there was an error of three-tenths or more, the bottles have been thrown out, not because three-tenths in practice is a serious error, but because it is better to insist that manufacturers shall furnish goods up to their guarantee.

For testing pipettes, an accurately graduated standard pipette is used. It is filled with mercury and then the contents are emptied into the pipette to be tested. If the point reached by the mercury coincides with the mark on the standard pipette, it is of course correct. All bottles and pipettes tested and found correct have been marked with the letters O. K., while those that are not correct are marked "off."

Only about one-half of the creameries of the State have sent their glassware to us, which indicates one of three things: (1) That those who have not responded are not using the test; (2) that they have obtained tested glassware from dealers, or (3) they have not complied with the law. In all, 1,498 cream bottles, 210 milk bottles and 96 pipettes were received prior to January 1st. Thirty-nine of the cream bottles were found to be more inaccurate than the prescribed limit, three-tenths of one per cent. and were consequently thrown out. Twenty-four of the number, however, were found in two small lots which evidently came from some unreliable manufacturer, as the error found was greater in those, in some cases over one-half of one per cent., than in any other lots. Of the 210 milk bottles all were correct, excepting 33 of one lot of 60. The errors in these bottles varied from three-tenths to one per cent. The source of these bottles could not be learned as they were found at the creamery when the parties now occupying it took possession. They were evidently made by some unreliable firm.

The glassware as a whole, however, has been very satisfactory and the new goods received from the manufacturers since the above act went into force have been exceptionally accurate, showing that the law has had the desired effect. No intentional fraud has been detected, the discrepancies discovered evidently being due to errors in graduating.

The law, although in most cases seeming unnecessary, cannot help being beneficial to all parties using the test, as it will eventually exclude the goods of unreliable manufacturers from the State, and will tend to increase confidence in the accuracy of the method upon which are based the payments for milk and cream.

The following is a list of the parties and creameries who have sent us their glassware to be tested:

E. E. Light, Union, Me.
West Paris Creamery, West Paris, Me.
Bethel Dairy, Bethel, Me.
Bridgton Creamery, Bridgton, Me.
W. L. Phillips, East Wilton, Me.
Forest City Creamery, Portland, Me.
Hillside Creamery, Exeter, Me.
A. L. & E. F. Goss Co., Lewiston, Me.
Turner Centre Creamery, Auburn, Me.
New Gloucester Creamery, New Gloucester, Me.
Wonder Brook Creamery, Kennebunk, Me.
John C. Gordon, Ellsworth, Me.
G. F. Gerry, Garland, Me.
Solon Creamery, Solon, Me.
Poland Dairy Association, Poland, Me.
I. O. Winslow, St. Albans, Me.
C. A. Whitney, Norridgewock, Me.
Bangor Creamery, Bangor, Me.
C. C. Nichols, Foxcroft, Me.
E. S. Dixon, Sabbatus, Me.
J. M. Tukey, New Castle, Me.
———Smith, Hampden, Me.
East Pittston Creamery, East Pittston, Me.

MAINE STATE COLLEGE.
ORONO, ME., March 25, 1896.

BULLETIN No. 27.

PEAS—SWEET CORN.

H. P. Gould.

PEAS.

It is a well known fact that nearly all of the earliest varieties of peas are what are commonly known as "smooth" or "hard" peas; the poor quality of this type is equally well known. One of the aims of the introducer has been to secure a sort which should possess the qualities of the later or "wrinkled" varieties and at the same time be as early as the smooth varieties. Efforts in this direction have been at least partially rewarded with success. There have been put upon the market during the past few years several varieties of the wrinkled type which are of excellent quality and also very early.

The purpose of this article is to call attention to a few of the newer varieties of peas which have given good satisfaction as grown in the station gardens.

Our usual rate of seeding has been one quart of seeds to 100 feet of drill, though it is probable that one quart to 75 or 80 feet of drill may be a more profitable rate.

The following descriptions are of "wrinkled" varieties of recent introduction which can be recommended for general cultivation.

Station, (Gregory):—Of moderately vigorous growth; 5 to 6 peas to the pod; quality good; maturing in from 45 to 55 days.

Morning Star, (Childs):—Growth somewhat less vigorous than Station; 5 to 6 peas to the pod; quality excellent; reaches edible maturity in 45 to 55 days.

Exonian, (Thorburn & Co.):—Vines medium height but very small; foliage noticeably light colored; about 6 peas to the pod; maturing in from 50 to 60 days.

Early Woodside, (H. N. Smith):—Of rather dwarf habit; 6 peas to the pod; quality good; from 60 to 70 days required to reach edible maturity.

Climax, (Northrup, Braslan & Goodwin Co.):—A very tall variety with rather small vines; one of the most prolific; quality not of the best; matures in about 70 days.

Echo, (Burpee):—A moderately vigorous grower; 7 peas to the pod; matures in from 65 to 75 days.

Renown, (Burpee):—Of rather dwarf habit; prolific; season medium to late.

Nott's Excelsior, (Maule):—A dwarf sort about 1 foot in height; 5 or 6 peas to the pod; matures in 50 to 55 days. Has received many favorable comments during the past 4 or 5 years.

The above are only a few of the many sorts which might be mentioned in the connection of "new varieties" but to increase the list would be doubtless to increase the indecision if one were selecting varieties for planting.

In our comparison of varieties such well known sorts as American Wonder, Heroine, Stratagem, Telephone, Abundance, and several others of like reputation have been taken as the standard of excellence.

Of the smooth peas, we will simply make mention of the following varieties: Maud S., Sunol, Summit, Rural New Yorker, Alaska, Daniel O'Rourke Improved. These varieties have no marked distinctive characteristics aside from the type and their chief value lies in the earliness of maturity.

It will be observed that in the foregoing descriptions considerable latitude is given for the time required by the different varieties to reach edible maturity. This wide variation is given from the fact the season has considerable influence upon the time required to reach edible maturity, the number of days being less in a warm than in a cold season. The same difference is noticeable in the time required for the maturity of early and late sowed peas of the same variety.

SWEET CORN.

Although corn has received no special attention at this station, several varieties have been grown each year and a few notes taken concerning their behavior.

Every one who is at all familiar with the catalogue of the average seedman is equally familiar with the high sounding and attractive description of varieties which most catalogues contain. We do not wish to infer that such descriptions are given for the purpose of deceiving, yet the fact remains that if one bases his anticipations on the descriptions which he finds, he is more than likely doomed to disappointment at the results which he obtains. While this condition of things does not exist in regard to the descriptions of corn to the extent that it does in regard to many other things, yet not a few of the statements are misleading. Especially have we found this to be true as to statements concerning the date of maturity. Very often varieties described as "early" have proven so late as to be almost worthless, and several so called medium sorts have failed to mature at all. A plausible excuse may appear, however, for this apparent deception when we consider the fact that practically all of the seeds disseminated by the larger seed companies are produced in a climate where the growing season is considerably longer than in Maine.

The following table represents most concisely the more important points relative to the varieties grown the past season:

Variety.	Source of Seed.	Date of first appearance of tassels.	Date of first appearance of silks.	Date of edible maturity.	Number days from planting to date of maturity.	Average length of ears—inches.	Average height of stalks—feet.
Best of All	H. W. Buckbee	July 24	Aug. 1	Sept. 2.	95	....	7.0
Cory (White)	J. M. Thorburn & Co	July 12	July 24	Aug. 17.	79	6.0	4.5
Crosby's Early	J. M. Thorburn & Co	July 20	Aug. 5	Sept. 2.	95	...	6.0
Early Dawn	Johnson & Stokes	July 24	Aug. 7	Sept. 7.	100	7.5	6.5
Early Sweet	D. M. Ferry & Co	July 24	Aug. 7	Sept. 11.	104	9.0	7.5
Early Sunrise	Iowa Seed Company	July 12	July 26	Aug. 17.	79	7.0	6.0
Early Vermont	A. W. Livingston's Sons,	July 12	July 26	Aug. 24.	86	....	4.0
Eastman's Early	Eastman Seed Company	July 12	July 26	Aug. 17.	79	...	4.0
Hance's Early	A. W. Livingston's Sons,	July 24	Aug. 10	Sept. 11.	104	7.5	6.5
Henderson Sugar	Peter Henderson & Co.	July 24	Aug. 7	Sept. 7.	100	9.0	8.0
Hickox Hybrid	D. M. Ferry & Co	July 17	Aug. 7	Sept. 7.	100	9.0	7.0
Honey	Johnson & Stokes	July 24	Aug. 10	Sept. 7.	100	8.0	8.0
Lackey's Early Sweet	J. J. H. Gregory & Son.	July 12	July 26	Aug. 17.	79	6.0	5.0
New England	D. M. Ferry & Co	July 15	Aug. 1	Aug. 31.	93	7.0	6.0
Perry's Hybrid	J. M. Thorburn & Co	July 20	Aug. 5	Sept. 7.	100	8.0	6.5
Quincy Market	J. J. H. Gregory & Co	July 15	July 30	Aug. 26.	88	....	5.0
Shaker's Early	A. W. Livingston's Sons,	July 24	Aug. 8	Sept. 11.	104	8.0	6.5
Stabler's Early	J. J. H. Gregory & Son.	July 29	....	Sept. 11.	104	8.0	7.5
Melrose	J. M. Thorburn & Co	July 26	Aug. 7	Sept. 5.	98	....	5.0
XX Sugar	W. H. Maule	July 24	Aug. 7	Sept. 11.	104	7.0	5.5
Livingston's Evergreen	A. W. Livingston's Sons,	July 24	Aug. 10	Sept. 15.	108	9.0	7.5
Acme Evergreen	Iowa Seed Company	July 29	Aug. 19	Did not reach edible maturity.	....	....	7.0
Burlington Hybrid	A. W. Livingston's Sons,	July 29	Aug. 7		....	....	7.0
Country Gentleman,	Johnson & Stokes	July 30	Aug. 17		....	....	7.0
Early Large Eight-rowed	A. W. Livingston's Sons.	July 27	Aug. 10		...	....	8.0

The varieties named above were all planted the last of May. The first killing frost was about the middle of September, so that in addition to the varieties which failed to reach edible maturity those which matured on or after September 11, of which there were several, were of but very little value for table use, as the date of edible maturity given in column five refers to the day on which the first ear was found which had reached an edible condition; this date, in most cases, was several days before enough ears could be picked to test the varieties.

For several years past the Cory has been the standard of earliness, but in quality it is far from perfection. As may be observed by referring to the table, several varieties were grown the past season which came to edible maturity on the same date as Cory—79 days from date of planting. The variety—Early

Sunrise—seems worthy of special mention. The quality compares very favorably with that of most later varieties and it was the most prolific variety grown.

Of the varieties which failed to reach edible maturity, we would call attention to the Country Gentleman, from the fact that since its introduction several years ago, no variety has received more favorable comment than this one, but for this State it is of little value on account of its lateness. It may mature under the most favorable conditions although it has been grown here for the past three years and in no case has it reached an edible condition before frosts, when given ordinary field culture.

For the benefit of those who may desire to purchase seeds direct of seedsmen the addresses of the seed merchants referred to in the above table are given herewith: J. M. Thorburn & Co., 15 John St., New York; Johnson & Stokes, Philadelphia, Pa.; D. M. Ferry & Co., Detroit, Mich.; A. W. Livingston's Sons, Columbus, Ohio; J. J. H. Gregory & Son, Marblehead, Mass.; Peter Henderson & Co., 35 and 37 Cortland St., New York; Iowa Seed Co., DesMoines, Iowa; Eastman Seed Co., East Sumner, Maine; Wm. Henry Maule, Philadelphia, Pa.; H. W. Buckbee, Rockford, Ill.

MAINE STATE COLLEGE,
ORONO, ME., March 18, 1896.

BULLETIN No. 28.

POTATO ROT—BORDEAUX MIXTURE AND FUNGIROID AS PREVENTIVES.

H. P. GOULD.

Potato rot or "late blight" as it is frequently called, is a common and at the same time, one of the most serious diseases of the potato. It is the result of the growth and development of a fungous plant within the tissues of the leaves and tubers. The first indication of the presence of the fungus is the browning of distinct areas upon the leaves; a portion of the leaf may be affected or the whole leaf may be involved. If the weather is warm and moist the disease usually spreads with great rapidity, a whole field assuming a brownish or blackened appearance within a few days from the first evidence of the presence of the malady; or if the weather is cool or dry, it may be difficult to distinguish the effect of the fungus from the natural maturing and dying of the foliage.

Early potatoes are seldom if ever injured, as the disease does not make its appearance until July or August.

Just how the tubers become infected is not known. The spores form on the under side of the leaves and fall to the ground. It is probable that these spores are washed by rains into the soil where they come in contact with the tubers and gaining entrance cause the well-known dry rot. It is possible that the mycelium of the fungus descends the stems and enters the tubers in that way, though the former manner of contamination is considered the more probable.

The injury due to the effects of the fungus may result from two causes. If the tops of the late potatoes are killed in July or August, the tubers will remain very small, even though they do not decay; but this latter condition almost invariably accompanies the dying of the tops, (if the dying be due to this fungus,) and when such is the case, the loss due to decay is usually much greater than from the former cause.

Although the direct effect of the disease on the tubers is to produce a dry rot, yet this unhealthy condition of the potato may often induce a "wet rot" which is especially noticeable at the time of digging.

If the weather is such that the fungus is developing rapidly, a very disagreeable and characteristic odor can usually be detected.

This subject has received much attention from experimenters during the past few years and some striking results have been obtained, proving almost beyond a doubt that the disease can be held in check if not absolutely prevented. Bordeaux mixture has invariably given the best results as a preventive of the malady.

By the use of Bordeaux mixture, at the Vermont Experiment Station, the total product in 1892 was increased from the rate of 169 bushels per acre from an unsprayed plat, to 400 bushels from a sprayed plat; at the Rhode Island Station, in 1890 the increase was 48 per cent., and several other stations report very favorable results.

Quite recently there has been put upon the market a fungicide known commercially as "fungiroid." This article is manufactured by Leggett & Brother, New York, and is said by them to be a powdered Bordeaux mixture and a substitute for that fungicide as ordinarily prepared. So far as I am aware, its qualities have not been thoroughly tested. If fungiroid should prove to be equally as effective as Bordeaux mixture, its advantage over the latter would be its ease of application. This applies especially in the treatment of low-growing plants.

During the past season the subject was given some consideration at this station. There were eighteen rows in the plat used for this work. The first row was sprayed with Bordeaux mixture; fungiroid was applied to the second, while the third was left untreated to serve as a check,—and so on throughout the plat—every third row in order receiving the treatment described above, making six rows sprayed with Bordeaux mixture, six treated with fungiroid and an equal number which received no treatment.

The first application of fungicides was made July 13; two other applications were subsequently made at intervals of about two weeks.

The following table gives a summary of each of the six rows:

BORDEAUX MIXTURE VS. FUNGIROID.

TREATMENT.	Total weight —pounds.	Ratio of yield.	Weight of decayed tubers —pounds.	Per cent. of decayed tubers.
Bordeaux	262¾	1.00	1.1	.4
Fungiroid	219	.83	18.7	8.5
Check	198¾	.75	20.3	10.2

Referring to the column, "ratio of yield," it will be observed that the total yield of the untreated rows was only 75 per cent. that of the rows sprayed with Bordeaux mixture, or an increase of 25 per cent. from the use of the Bordeaux; the total yield from the rows treated with fungiroid was 83 per cent. that of the rows sprayed with Bordeaux, or an increase of 17 per cent. in favor of Bordeaux mixture over fungiroid.

The last column gives the per cent. of decayed tubers. The rows sprayed with Bordeaux mixture produced only .4 of 1 per cent. by weight of decayed tubers, while from the unsprayed rows over 10 per cent. by weight of the tubers was decayed. The fungiroid seemed to have but little effect in preventing the decay.

The results do not promise the future for the fungiroid which had been hoped for it, yet we do not wish to draw final conclusions from this one season's trial.

In spraying potatoes for the prevention of the "blight," the first application should be made sometime from the first to the middle of July and subsequent applications should be made at intervals of from ten days to three weeks, depending upon the weather, rainy weather requiring more frequent applications than dry.

If potato bugs are numerous, Paris green may be added to the Bordeaux mixture at the rate of 1 ℔. to 150 gallons of the mixture.

The directions for preparing Bordeaux mixture given in the annual report of the Maine Experiment Station for 1889, may be varied somewhat. The following formula is the one most commonly used: 6 ℔s. copper sulphate, 4 ℔s. fresh unslaked lime, 45 gallons water. Dissolve the copper sulphate in a small quantity of water; slake the lime, adding a few quarts of water after the lime is slaked, and when cool mix with the copper sulphate solution and dilute with enough water to make in all 45 gallons. It is advisable to strain the lime solution before adding to the copper sulphate, as it usually contains more or less coarse material which would clog the spraying apparatus.

The copper sulphate should not be dissolved, nor should the Bordeaux mixture be prepared, in an iron vessel, as the copper compound will act upon the iron.

RECAPITULATION.

Potato rot, late blight or rust, as the disease is variously called, is the result of a fungous parasite; this disease can be held in check if not entirely prevented by the use of fungicides of which

Bordeaux mixture is the most satisfactory. The first application should be made early in July, followed by a second, after a lapse of from ten days to three weeks, according to the weather. Three or four applications should be made.

MAINE STATE COLLEGE,
ORONO, ME., March 31, 1896.

BULLETIN No. 29.

NOTES ON SPRAYING.

W. M. MUNSON.

The fact that insect and fungous enemies of the orchard may be held in check by careful attention to spraying with certain materials, has been so often and so plainly demonstrated that further proof seems unnecessary. By our more progressive farmers the practice is now looked upon as a necessity in successful orchard management, and there are frequent requests for information. To meet these inquiries, and to again call the matter to the attention of others, a brief review of the subject seems desirable at this time. Some points will be more fully discussed in the annual report for the current year.

Preparation for the Work:—If not already attended to, the necessary pumps and nozzles should at once be secured; likewise the chemicals—except the lime for Bordeaux mixture, which should be fresh when used. If a pump is already at hand it should be examined and the packing of the valves should be renewed. Be sure also that the hose is in good condition, as otherwise much valuable time may be lost later in the season.

It is advisable at this time also to prepare the necessary wagon or cart for use when spraying. In low-headed orchards an ordinary stone-boat or low wagon may serve the purpose well.

What is the best pump?—There are so many good pumps on the market at present it is not easy to give a specific answer to the question. The "Eclipse" made by Morrill & Morley, Benton Arbor, Mich., is highly recommended by some, but personally I have not used this form. The Field Force Pump Company, Lockport, N. Y.; The Goulds Manufacturing Company, Seneca Falls, N. Y.; The Deming Company, Salem, Ohio; W. & B. Douglass, Middletown, Conn., and many other reliable firms are sending out very good pumps. These firms will all send catalogues free on application.

The best nozzle that we have used is the "McGowen," made by John J. McGowen, Ithaca, N. Y., and costs $1.00.

When to spray and why:—No definite time for beginning the work can be stated as this will depend on the season and on the object in view. It is of course understood that the arsenites—of which Paris green is preferred—are used to destroy insects which eat the leaves or fruit, such as bud-moth, canker-worm, codling-moth, etc. The copper salts, of which the best preparation is the Bordeaux mixture, are used to prevent the spread of fungous diseases such as apple scab, brown rot, etc. If the two classes of enemies are to be met, the remedies may be applied at one operation.

In general our recommendation for preventing apple scab would be to spray with Bordeaux mixture just before the fruit buds open, again with the same just as the blossoms fall, and repeat the operation once or twice at intervals of two or three weeks if the season is wet. In the first two lots applied, Paris green should be added in the proportion of 1 ℔ to 150 or 200 gallons, thus destroying leaf-eating insects and the codling-moth.

At least three sprayings should be given as above, and many would advise treatment with a solution of pure copper sulphate —1℔. to 15 gallons water—before the buds burst in spring. There is some question about the importance of this early treatment, but in our own experience such treatment has usually been found advantageous.

Preparation of Bordeaux mixture:—It would seem that this most important of the fungicides should now be perfectly familiar to every orchardist; but it is still a subject of frequent inquiry. As usually prepared the mixture consists of 6 ℔s. copper sulphate, 4 ℔s. quick lime and 50 gallons water. The copper salt is dissolved in a wooden tub, the lime slaked in a separate vessel and when ready for use the two are mixed and diluted as above.

In large orchards much time may be saved by preparing stock solutions of the lime and copper instead of constantly making up a new batch. Dissolve 40 ℔s. of copper sulphate in as many gallons of water. A gallon of the solution will thus contain 1 ℔. of the copper salt. In a similar way a stock solution of lime may be prepared. Keep both solutions tightly covered and stir thoroughly before dipping any out. A gallon of clear lime water contains only one-sixth of an ounce of lime instead of a pound, as desired. It is now a very simple matter to take six gallons of the copper solution, four of the lime and dilute to the requisite amount.*

Some other formulas:—The Bordeaux mixture and Paris green above mentioned are the standard remedies for orchard work. But there are some insects which are best reached by other means, and it is assumed that the orchardist knows what he is fighting before commencing operations. For currant worms, the specific—after the fruit has set—is fresh white hellebore. For the first brood of this insect we always use Paris green. Aphis and scale insects are best met with kerosene emulsion. For brown rot of plums, after the fruit has partly developed, the ammoniacal solution of copper carbonate is preferred to Bordeaux mixture, as the latter discolors the fruit.

KEROSENE EMULSION.

Hard soap	½ pound.
Boiled water	1 gallon.
Kerosene	2 gallons.

Dissolve the soap in the water, add the kerosene and churn through a force pump for five to ten minutes. In general, dilute about ten times before using. On very tender succulent plants dilute fifteen or twenty times, and for scale insects on woody plants dilute only five times.

HELLEBORE.

Fresh white hellebore	1 ounce.
Water	3 gallons.

A little flour paste added to the mixture will cause it to adhere to the foliage better.

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*This subject was fully discussed before the Maine Pomological Society in January, 1895. See Rep. Maine Pom. Soc., 1894, p. 56.

AMMONIACAL COPPER CARBONATE.

Copper carbonate	1 ounce.
Ammonia water	1 quart.
Water	9 gallons.

For this purpose take the strongest ammonia, 26 degrees Beaumé, and dilute it with seven or eight volumes of water before using. This stock solution may be kept indefinitely in closely corked bottles. Dilute as above when ready for use. Several other formulas for the solution of copper carbonate are given, but this one will be found most convenient.

There are many other valuable insecticides and fungicides, but those above named are the most important. It is hoped that the warfare against disease and insect enemies of the orchard will be waged this year as never before.

MAINE STATE COLLEGE,
ORONO, ME., April 10, 1896.

BULLETIN No. 30.

INSPECTION OF FERTILIZERS, 1896.

The bulletin gave the manufacturer's guarantees, the analyses of manufacturer's samples and of samples collected by the Station, but as these figures are of only passing value they are omitted here.

BULLETIN No. 31.

A MODIFICATION OF THE BABCOCK METHOD AND APPARATUS FOR TESTING MILK AND CREAM.

J. M. BARTLETT.

The modifications described in this bulletin, briefly stated, are as follows:

The modification of the method consists chiefly in filling the bottles with hot water after the milk or cream and acid are added, before they are put in the centrifugal machine and whirled. In this way the separation is completed with one whirling and the time required for the second whirling is saved.

The modifications of the apparatus are: The base portions of the milk and cream bottles are graduated so that no acid measure is required and the base portion of the cream bottle is reduced in size.

While working with the Babcock test some months ago it occurred to the writer that separating the fat before adding water was an unnecssary part of the process if the right conditions could be brought about and that the hot water might be added directly after mixing the acid and milk together. Accordingly, to decide the matter, a series of experiments were conducted, resulting in the adoption of the following method, which has been used successfully for the past six months with all kinds of milk and cream.

METHOD FOR MILK.

After the milk is mixed by stirring or pouring from one vessel to another, the required amount, 17.6 cubic centimeters, is measured into the test bottle. It is then heated to about 70 degrees Fahrenheit, if not already at that temperature, by setting the bottles in a tank of warm water. Twenty cubic centimeters of sulphuric acid (specific gravity 1.82 to 1.825) are added and the bottle shaken by giving it a rotary motion until the milk and acid are thoroughly mixed. The mixture is then allowed to stand not less than five minutes. No harm is done if it stands longer than five minutes and in fact, occasionally, some kinds of milk have to be given a little more time. After standing the necessary time the bottle is given another gentle shake to mix in and dissolve any particles of curd that may have risen to the surface. Hot water is then added nearly to the uppermost mark, the bottle is put in the centrifugal machine and whirled for five minutes at the rate of 1,000 to 1,200 revolutions per minute. A steam turbine machine is best for this purpose but a hand or belt power machine can be used, if hot water is put in the pan to keep the fat melted. After the whirling is completed the percentage of fat can be read off in the usual manner.

It would appear that the time required for the bottles to stand after the acid is mixed with the milk, would offset that gained by omitting the second whirling which is made in the old method; but the writer has often found it necessary with many kinds of milk, especially with that from cows much advanced in the period of lactation, to allow the bottles to stand a while, even when working the two whirling method, in order to get a clear separation of fat. However, every one who does much testing should have at least two sets of bottles, so there would be no loss of time by this process. When two sets of bottles are at hand one set, charged with the milk and acid, can stand while the second set is being filled, and the second set can stand while the first is being whirled. It is much better to make twelve tests at a time than to make a larger number. Twelve are about all one can easily read off before the fat begins to cool and contract in volume.

For the above described modification of the milk test no change of apparatus need be made, but the writer, however, prefers to have the base portion of the bottle graduated as before mentioned so no acid measure is required and only one pouring of the acid is necessary. By having the bottle marked at the point A, Fig. 1, at which mark it holds 37.5 cubic centimeters, one can, after the milk is measured in with the pipette, run the acid in until it is filled to this point. It was found impracticable to use a bottle with a smaller base capacity like the cream bottle described farther on, because of the larger amount of curd in milk than in cream and the small size of the neck of the milk bottle necessitating more space for shaking, breaking up the curd and dissolving it in the acid.

THE CREAM BOTTLE.

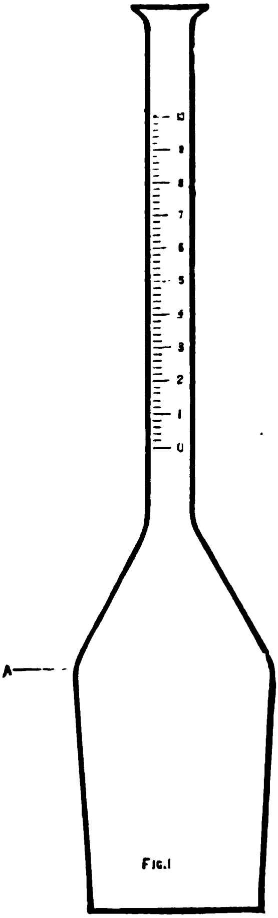

FIG. 1

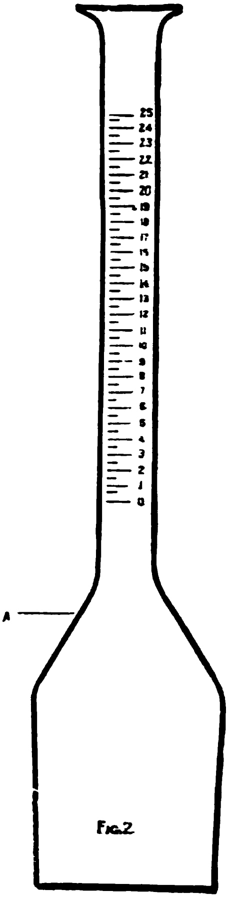

FIG. 2

The bottle here described (Fig. 2) is similar to the regular milk bottle, and also to the Connecticut Station cream bottle, except that the base portion is made of such size as to avoid using an acid measure. The base is made to hold about 38 cubic centimeters up to the neck and after the cream is measured in, the required amount of acid can be added by filling the bottle nearly to the neck or to the point A shown in the cut. The neck portion is large enough to carry 25 per cent. of fat and is graduated to one-half of one per cent. and can be easily read to one-quarter of one per cent. Each per cent. is numbered. Although one cannot read so closely with this as with the bulb neck bottle (described in Bulletin No. 3, Second Series, Maine Experiment Station), which was designed to test both milk and cream, one can read fine enough for all practical purposes. On account of the neck being larger and shorter, this bottle is more easily cleaned than either of the older forms; it is less liable to breakage, and by using the method previously given for milk a test can be made more rapidly. Twenty-five per cent. was fixed upon as the capacity of the neck for the reason that a much higher percentage necessitates an increase in diameter which impairs the accuracy in reading and again, nearly all cream shipped to the creameries is raised by the cold deep setting process and seldom contains more than twenty per cent. of fat. If one wishes to test separator cream that is very rich, 9 cubic centimeters or 9 grams of the cream can be taken instead of 18, 9 cubic centimeters of water added and the usual amount of acid. The per cent. of fat obtained in that case of course should be multiplied by two, to give a correct reading.

COMPARISON OF RESULTS OBTAINED BY OLD AND NEW METHODS.

Below are given, in tabular form, a few of the many results obtained on milk and cream in comparing the old method with the one whirling method.

MILK.		MILK.		MILK.		CREAM.	
Whirled once.	Whirled twice.	Whirled once.	Whirled twice.	Whirled once.	Whirled twice.	Whirled once.	Whirled twice.
% 5.3	% 5.8	% 5.2	% 5.8	% 3.8	% 3.7	% 18¾	% 18¾
5.6	5.6	5.3	5.4	4.1	4.2	18½	18¾
6.0	3.0	4.7	4.8	5.2	5.0	18¾	18¾
4.9	4.9	5.0	4.9	5.1	5.2	18½	18¾
4.9	5.0	5.6	5.8	5.3	5.1	23½	23¼
5.2	5.2	5.0	5.0	5.0	5.0	23¾	......
4.6	4.6	4.9	4.9	5.0	5.2	17	17¼
5.0	5.1	4.9	5.0	5.7	5.8	19¼	19

METHOD FOR CREAM.

The method employed for cream is as follows:

Measure 18 cubic centimeters or weigh 18 grams of the thoroughly mixed cream, carrying not more than 25 per cent. of fat, into the bottle. Heat it to about 70° F. if not already at that temperature, then fill the bottle up nearly to the base of the neck (point A, fig. 2) with sulphuric acid, specific gravity 1.82. The acid can be handled in a sharp-nosed pitcher or run in from a syphon affixed to a bottle or carboy. Mix the acid and cream together thoroughly, which is best done by grasping the neck with the hand, pressing the thumb tightly over the opening and then giving the bottle a rotary motion, holding it upright all the time. The confined air prevents the curd from coming up and sticking to the sides of the neck. The mixing is just as easily done in this as in the old style bottle. The remainder of the process is conducted exactly the same as for testing milk previously given.

If the above directions are followed, a perfectly clear separation will be obtained and also a considerable saving of time over the old method, as only one pouring of the acid and one whirling of the machine are made.

WEIGHING CREAM FOR THE TEST INSTEAD OF MEASURING.

Cream containing twenty-five per cent. of fat or less when sweet and not frothing can be measured with sufficient accuracy to give good results. But when such cream becomes sour it is impossible to get it in condition to measure without a good deal of trouble. If it is simply broken up by shaking, as is often done, it will contain so many air bubbles that the cream drawn into the pipette will weigh less than 18 grams. To illustrate what a difference there is the writer made several tests of sweet cream, then the same samples were allowed to stand in the jars until sour, broken up by simply shaking and tests made by both weighing and measuring out the samples.

	Sweet cream measured.	Sour cream measured.	Sour cream weighed.
No. 1.	17¼%	14¼%	17¼%
No. 2	18	16	18¼
No. 3	20¼	18½	20¼

Thick separator cream, which will always contain air bubbles if stirred enough to get a good sample, cannot be accurately measured and must be weighed to get a reliable result; and the writer has become thoroughly convinced that it is necessary for every creamery to have some means at hand to test such cream accurately. For this purpose the Station is having a special weighing scale made with which one can weigh nearly as rapidly as he can measure with a pipette. When completed it will be on sale by dealers in testing apparatus.

PRECAUTIONS.

That good results and clear separations can be obtained by the previously described modifications the writer and others connected with the College have fully demonstrated. It is necessary, however, that certain details be strictly observed to attain success and to make those points more prominent they are repeated as precautions.

1st. *The acid must be of the proper strength;*—1.82 specific gravity at 60 degrees Fahrenheit is more universally successful than a stronger acid, though 1.825 may be used in some cases. With very rich milk 20 to 21 c. c. of acid of 1.82 specific gravity works much better than a smaller quantity of strong acid, probably because there is less water in rich milk to properly dilute the acid than in poor milk. Rather thin milk will give good results with acid of quite varying strength. If the acid is too strong the fat will be blackened or black particles will appear in the lower part of the fat column. If the acid is not strong enough the fat will appear cloudy and white particles of curd will collect at the lower part of the column so that an accurate reading cannot be made.

2nd. *The milk or cream should not be colder than 70° Fahrenheit or warmer than 80° Fahrenheit when the acid is added.* If the milk or cream is too cold the curd will not all be dissolved in the time allowed, and the fat will appear cloudy with white particles in the lower part of the column which will interfere with the reading. If the milk or cream is too warm the action of the acid will be too violent, the fat will be burned and the whole column appear blackened or if only slightly burned black particles will appear in the lower part of the column.

3rd. *The acid and milk or cream must be thoroughly mixed together and the mixture stand not less than five minutes before hot water is added; otherwise a clear separation will not be obtained.* It is also best to shake the bottle again slightly, just before adding the hot water, to dissolve any particles of curd that have risen with the fat.

4th. *The bottles must be whirled and heat applied as directed or the separation is liable to be incomplete.* Sometimes a cloudy fat can be cleared by heat and longer whirling.

INSPECTION LAWS IN FORCE IN MAINE.

The text of the laws to regulate the sale and analysis of commercial fertilizers, the testing of glassware used at creameries, and to regulate the sale and analysis of commercial concentrated feeding stuffs are given in full. The law regulating the sale of agricultural seeds is not an inspection law but as it is an important law and some of its provisions are entrusted to the Station Director, it is also printed herewith in full.

An Act to regulate the sale and analysis of Commercial Fertilizers.

Section 1. Every manufacturer, company or person who shall sell, offer or expose for sale in this state any commercial fertilizer or any material used for fertilizing purposes, the price of which exceeds ten dollars per ton, shall affix to every package of such fertilizer in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in the package sold or offered for sale, the name or trade mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business and a chemical analysis stating the percentage of nitrogen, or its equivalent in ammonia in available form, of potash soluble in water, and of phosphoric acid in available form, soluble and reverted as well as the total phosphoric acid.

Sect. 2. Every manufacturer, company or person who shall sell, offer or expose for sale in this state any commercial fertilizer or material used for fertilizing purposes, the price of which exceeds ten dollars per ton, shall for each and every fertilizer bearing a distinguishing name or trade mark, file annually with the Director of the Maine Agricultural Experiment Station, between the fifteenth day of November and the fifteenth day of December, a certified copy of the statement, named in section one of this act, said certified copy to be accompanied, when required, by a sealed glass jar or bottle containing at least one pound of the fertilizer to be sold or offered for sale, and the company or person filing said certified copy with its accompanying sample of fertilizer shall thereupon make affidavit that said sample corresponds within reasonable limits to the fertilizer which it represents in the percentage of nitrogen, total and available phosphoric acid, and potash soluble in water which it contains. Such affidavit shall apply to the entire calendar year next succeeding the date upon which said affidavit is made, unless the person or persons making such affidavit shall give notice to the Director of the Maine Experiment Station that a change is to be made during the year in the percentages of the above named ingredients contained in the fertilizer, in which case he shall, before selling or offering for sale such fertilizer, file another certified statement with an accompanying sample of fertilizer and an affidavit as hereinbefore required. The deposit of a sample of fertilizer as herein provided shall be required by said Director unless the company, manufacturer or person selling or offering for sale a fertilizer coming within the provisions of this act, shall certify that its composition for the succeeding year is to be the same as given in the last previously certified statement, in which case the requiring of said sample shall be at the discretion of said Director.

Sect. 3. The Director of the Maine Experiment Station shall analyze, or cause to be analyzed, all the samples of fertilizers which come into his possession under the provisions of section two of this act, and shall publish the results thereof in a bulletin or report on or before the fifteenth of March next succeeding.

Sect. 4. Any manufacturer, importer, agent or seller of any commercial fertilier, who shall deposit with the Director of the Maine Experiment Station a sample or samples of fertilizer under the provisions of section two of this act, shall pay annually to said Director an analysis fee as follows: Ten dollars for the phosphoric acid and five dollars each for the nitrogen and potash, contained or said to be contained in the fertilizer, this fee to be assessed on any brand sold in the State, and upon receipt of such fee and of the certified statement named in section two of this act, said Director shall issue a certificate of compliance with this act. Whenever the manufacturer or importer of a fertilizer shall have filed the statement made in section two of this act and paid the analysis fee, no agent or seller of said manufacturer, importer or shipper shall be required to file such statement or pay such fee. The analysis fees received by said Director shall be paid immediately by him into the treasury of said Experiment Station.

Sect. 5. Any manufacturer, importer or person who shall sell, offer or expose for sale in this State any commercial fertilizer without complying with the requirements of sections one, two and four of this act, or any fertilizer which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent offense.

Sect. 6. The Director of the Maine Experiment Station shall annually analyze, or cause to be analyzed, at least one sample, to be taken in the manner hereinafter prescribed, of every fertilizer sold or offered for sale under the provisions of this act. Said Director is hereby authorized and directed in person or by deputy to take a sample not exceeding two pounds in weight, for said analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer in this State; but said sample shall be drawn in the presence of said party or parties in interest, or their representative, and taken from a parcel or a number of packages which shall not be less than ten per cent. of the whole lot sampled, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the Director or his deputy and by the party or parties in interest or their representatives at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the Director and the other by the party whose stock was sampled; and the sample or samples retained by the Director shall be for comparison with the certified statement named in section two of this act. The result of the analysis of the sample or samples so procured shall be published in a report or bulletin within reasonable time.

Sect. 7. Whenever the Director becomes cognizant of the violation of any of the provisions of this act he shall report such violation to the Secretary of the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported; but it shall be the duty of said Secretary upon thus ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of any fertilizer or fertilizing material if the same shall be found substantially equivalent to the certified statement named in section two of this act.

Sect. 8. All acts and parts of acts inconsistent with this act are hereby repealed.

Sect. 9. This act shall take effect when approved.

Approved February 24, 1897.

CHAPTER 169.

An Act for the Protection of Dairymen.

Section 1. All bottles, pipettes or other measuring glasses used by any person, firm or corporation, or their agents or employes, at any creamery, butter factory, cheese factory or condensed milk factory, or elsewhere in this State, in determining by the Babcock test, or by any other test, the value of milk or cream received from different persons or parties at such creameries or factories, shall before such use be tested for accuracy of measurement and for accuracy of the per cent. scale marked thereon. Such bottles, pipettes or measuring glasses shall bear in marks or characters ineffaceable the evidence that such test has been made by the authority named in section two of this act. And no inaccurate bottles, pipettes or other glasses shall bear such marks or characters.

Sect. 2. It is hereby made the duty of the Director of the State College Experiment Station, or other competent person designated by him, to test the accuracy of all bottles, pipettes or other measuring glasses used by persons, firms or corporations in this State buying or pooling milk or cream, or apportioning butter or cheese made from the same, by the contents of butter fat contained therein. The Director of the Experiment Station or the person designated by him, shall mark such bottles, pipettes or other measuring glasses as are found correct, in marks or characters which cannot be erased, and which marks or characters shall stand as proof that they have been so tested. The Director of the Experiment Station shall receive for such service the actual cost incurred, and no more, the same to be paid by the persons or corporations for whom it is done.

Sect. 3. Any person, either for himself or in the employ of any other person, firm or corporation, who manipulates the Babcock test or any other test, whether mechanical or chemical, for the purpose of measuring the contents of butter fat in milk or cream for a basis of apportioning the value of such milk or cream, or the butter or cheese made from the same, shall secure a certificate from the superintendent of the dairy school at the State College of Agriculture and Mechanic Arts that he or she is competent and well qualified to perform such work. The rules and regulations in the application for such certificate and in the granting of the same shall be such as the superintendent of that school may arrange, and the fee for issuing a certificate shall in no case exceed one dollar, the same to be paid by the applicant.

Sect. 4. Whoever uses, or has in his possession with intent to use, at any creamery, butter factory, cheese factory or condensed milk factory, any sulphuric acid of less than one and eighty-two hundredths of specific gravity in the process known as the Babcock test, or any other test for determining the butter fat contents of milk or cream, shall on conviction pay a fine not exceeding twenty-five dollars for the first offense, and for a second offense a sum not exceeding fifty dollars. Any person, firm or corporation violating the provisions of section one of this act, shall on conviction pay a fine not exceeding fifty dollars for the first offense, and for a second offense a sum not exceeding one hundred dollars; and any person violating section three of this act shall on conviction pay a fine not exceeding ten dollars. And it shall be the duty of every inspector of milk, sheriff, deputy sheriff and constable to institute complaint against any person or persons violating the within named provisions of this act, and on conviction one-half of the fines shall go to complainant and the balance to the State.

Sect. 5. This act shall take effect in six months from the date of its approval.

Approved March 27, 1895.

CHAPTER 334.

An Act to regulate the sale and analysis of Concentrated Commercial Feeding Stuff.

Section 1. Every manufacturer, company or person who shall sell, offer or expose for sale or for distribution in this State any concentrated commercial feeding stuff, as defined in section three of this act, used for feeding farm live stock, shall, in addition to the tax tag described in section five of this act, affix to every package of such feeding stuff, in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in the package sold or offered for sale, the name or trade mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business and a chemical analysis stating the percentage of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, and of crude fat it contains, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists.

Sect. 2. The term concentrated commercial feeding stuff, as here used, shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat, and broom corn. Neither shall it include wheat, rye and buckwheat brans or middlings, not mixed with other substances, but sold separately, as distinct articles of commerce, nor pure grains ground together.

Sect. 3. The term concentrated commercial feeding stuff, as here used, shall include linseed meals, cotton-seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewer's grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, ground beef or fish scraps, mixed feeds, and all other materials of similar nature not included within section two of this act.

Sect. 4. Before any manufacturer, company or person shall sell, offer or expose for sale in this State any concentrated commercial feeding stuff, as defined in section three of this act, he or they shall for each and every feeding stuff bearing a distinguishing name or trade mark, file with the Director of the Maine Agricultural Experiment Station a certified copy of the statement named in section one of this act, said certified copy to be accompanied, when the Director shall so request, by a sealed glass jar or bottle containing at least one pound of the feeding stuff to be sold or offered for sale, and the company or person furnishing said sample shall thereupon make affidavit that said sample corresponds within reasonable limits to the feeding stuff which it represents, in the percentage of protein and fat which it contains.

Sect. 5. Each manufacturer, importer, agent or seller of any concentrated commercial feeding stuff, as defined in section three of this act, shall pay to the Director of the Maine Agricultural Experiment Station an inspection tax of ten cents per ton for each ton of such concentrated feeding stuff sold or offered for sale in the State of Maine, and shall affix to each car shipped in bulk and to each bag, barrel or other package of such concentrated feeding stuff, a tag to be furnished by said Director, stating that all charges specified in this section have been paid. The Director of said Experiment Station is hereby empowered to prescribe the form for such tags, and adopt such regulations as may be necessary for the enforcement of the law. Whenever the manufacturer or importer or shipper of a concentrated feeding stuff shall have filed the statement made in section one of this act and paid the inspection tax, no agent or seller of said manufacturer, importer or shipper shall be required to file such statement or pay such tax. The amount of inspection tax received by said Director shall be paid by him into the treasury of the Maine Agricultural Experiment Station. The treasurer of said Station shall make an annual report of receipts and expenditures of funds from this inspection tax, and all receipts in excess of three thousand dollars shall be carried into the state treasury.

Sect. 6. Any manufacturer, importer or person who shall sell, offer or expose for sale or for distribution in this state any concentrated commercial feeding stuff, as defined in section three of this act, without complying with the requirements of the preceding sections of this act, or any feeding stuff which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined not more than one hundred dollars for the first offense, and not more than two hundred dollars for each subsequent offense.

Sect. 7. The Director of the Maine Experiment Station shall annually analyze, or cause to be analyzed, at least one sample to be taken in the manner hereinafter prescribed, of every concentrated commercial feeding stuff sold or offered for sale under the provisions of this act. Said Director is hereby authorized and directed in person or by deputy to take a sample, not exceeding two pounds in weight, for said analysis, from any lot or package of concentrated commercial feeding stuff which may be in the possession of any manufacturer, importer, agent or dealer in this state; but said sample shall be drawn in the presence of said party or parties in interest, or their representative, and taken from a parcel or a number of packages, which shall not be less than ten per cent. of the whole lot sampled, and shall be thoroughly mixed, and then divided into two equal samples, and placed in glass vessels, and carefully sealed and a label placed on each, stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the Director or his deputy and by the party or parties in interest or their representative at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the Director and the other by the party whose stock was sampled; and the sample or samples retained by the Director shall be for comparison with the certified statement named in section four of this act. The result of the analysis of the sample or samples so procured, together with such additional information as circumstances advise, shall be published in reports or bulletins from time to time.

Sect. 8. Whenever the Director becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the Secretary of the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported; but it shall be the duty of said Secretary, upon thus ascertaining any violation of this act, to forthwith notify the manufacturer, importer or dealer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of any concentrated commercial feeding stuff if the same shall be found substantially equivalent to the certified statement named in section four of this act.

Sect. 9. All acts and parts of acts inconsistent with this act are hereby repealed.

Sect. 10. This act shall take effect October first, eighteen hundred and ninety-seven.

Approved March 27, 1897.

CHAPTER 313.

An Act to regulate the sale of Agricultural Seeds.

Section 1. Every lot of seeds of agricultural plants, whether in bulk or in package, containing one pound or more, and including the seeds of cereals, (except sweet corn), grasses, forage plants, vegetables, and garden plants but not including those of trees, shrubs and ornamental plants, which is sold, offered or exposed for sale for seed by any person or persons in Maine, shall be accompanied by a written or printed guarantee of its percentage of purity, freedom from foreign matter; provided, that mixtures may be sold as such when the percentages of the various constitutents are stated.

Sect. 2. Dealers may base their guarantees upon tests conducted by themselves, their agents, or by the Director of the Maine Agricultural Experiment Station; provided, that such tests shall be made under such conditions as the said Director may prescribe.

Sect. 3. The results of all tests of seeds made by said Director shall be published by him in the bulletins or reports of the Experiment Station, together with the names of the person or persons from whom the samples of seeds were obtained. The said Director shall also publish equitable standards of purity together with such other information concerning agricultural seeds as may be of public benefit.

Sect. 4. Any person or persons who shall sell, offer or expose for sale or for distribution in this State agricultural seeds without complying with the requirements of sections one and two of this act, shall, on conviction in a court of competent jurisdiction, be fined not to exceed one hundred dollars for the first offense, and not to exceed two hundred dollars for each subsequent offense.

Sect. 5. Any person or persons who shall, with intention to deceive, wrongly mark or label any package or bag containing garden or vegetable seeds or any other agricultural seeds, not including those of trees, shrubs, and ornamental plants, shall be guilty of a misdemeanor and upon conviction in a court of competent jurisdiction shall be fined not to exceed one hundred dollars for the first offense and not to exceed two hundred dollars for each subsequent offense.

Sect. 6. The provisions of this act shall not apply to any person or persons growing or selling cereals and other seeds for food.

Sect. 7. Whenever the Director of the Maine Agricultural Experiment Station becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the Secretary of the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported.

Sect. 8. All acts and parts of acts inconsistent with this act are hereby repealed.

Sect. 9. This act shall take effect September one, eighteen hundred ninety-seven.

Approved March 26, 1897.

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